

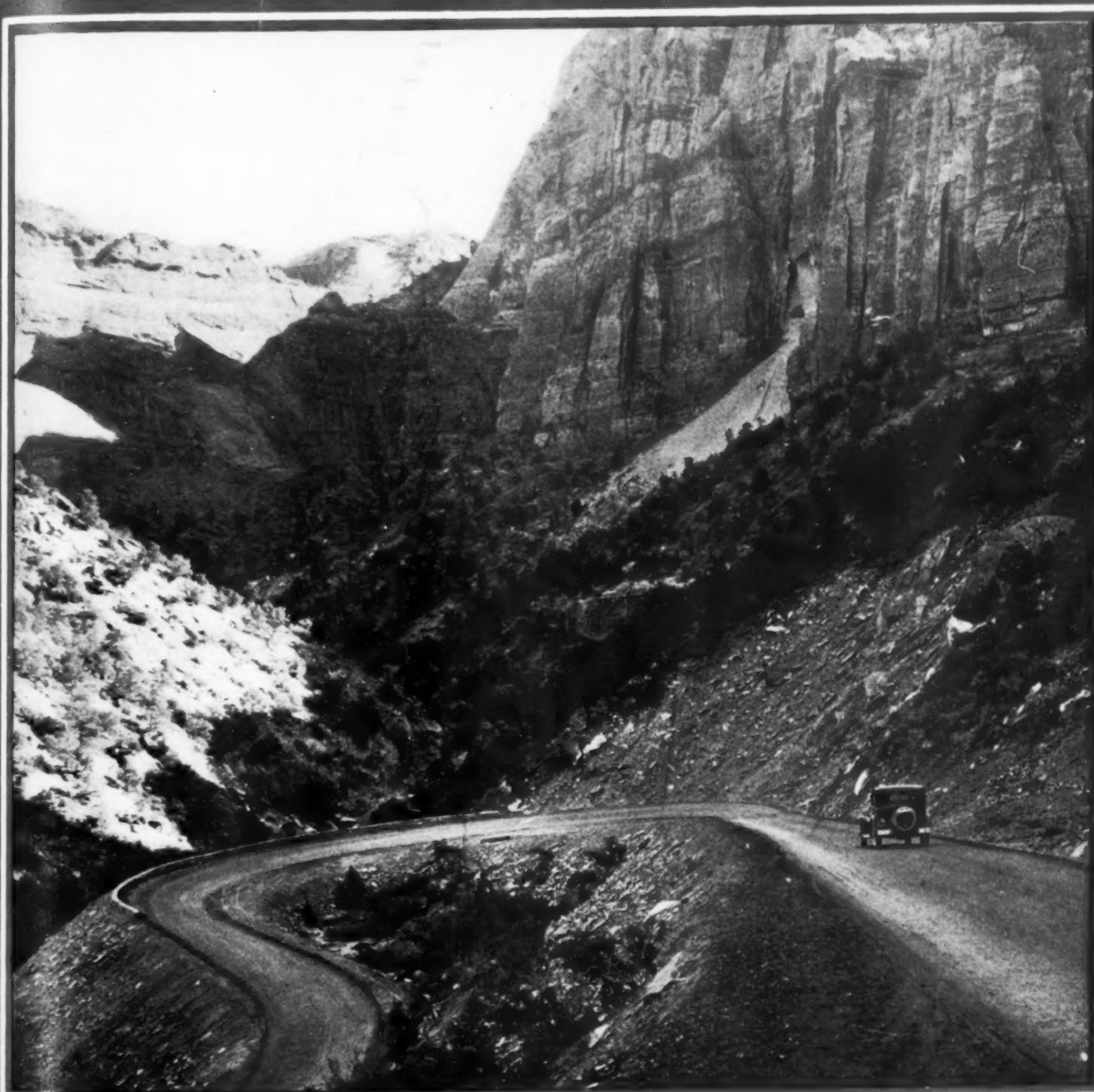
Engineering
Library

PUBLIC WORKS

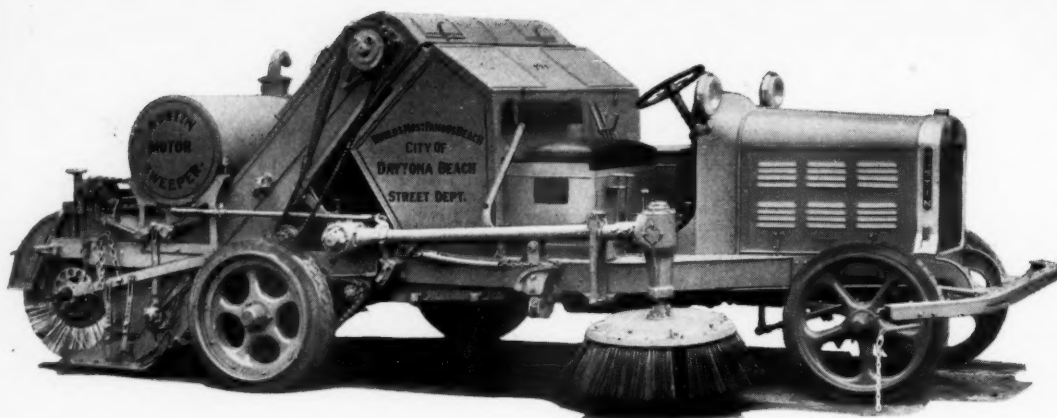
CITY

COUNTY

STATE



MAY, 1931



Daytona Beach ...

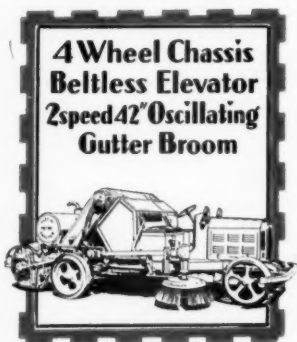
where records are broken, uses an

Austin Motor Sweeper

Daytona Beach, Florida, a city manager city, has seen a number of world's speed records eclipsed on its famous racing beach. The most recent was that of Capt. Malcolm Campbell, when he established a new world's speed record of 245.733 miles per hour.

As an up-and-coming resort city anxious to attract tourists, it realized the importance of spotless streets. So satisfactory have Austin Motor Sweepers proven in operating efficiency and freedom from costly upkeep that

it was only natural for this well-managed city to select the Austin.



Write today for information on the Austin Motor Sweeper. We will be glad to send it. The Austin-Western Road Machinery Co., 400 N. Michigan Ave., Chicago, Illinois.

Austin-Western

ROAD MACHINERY

GALION

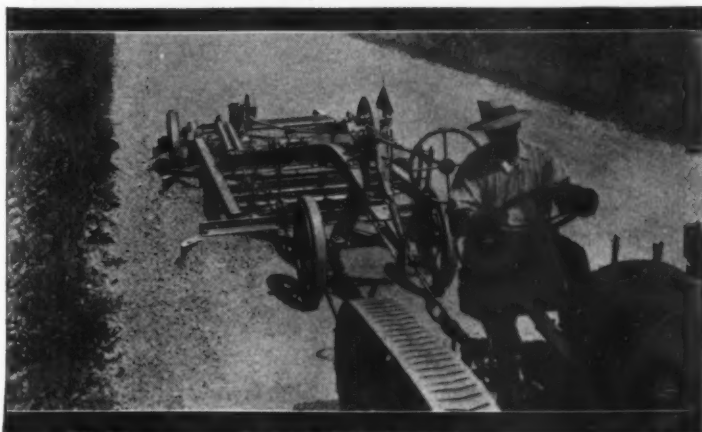
Multiple Blade Maintainer

... One Man Control



GALION DISTRIBUTORS

ALABAMA, Birmingham—G. C. Phillips Trac. Co., Inc.
ARIZONA, Tucson—F. Ronstadt Co.
ARKANSAS, Little Rock—Murphy & Murphy.
CALIFORNIA, Los Angeles—Smith-Booth-Usher Co.
San Francisco—Jemison Machinery Co.
CANADA, Montreal—Jeffrey Mfg. Co., Ltd.
Vancouver—Brown Fraser & Co., Ltd.
COLORADO, Denver—H. W. Moore Equipment Co.
CONNECTICUT, New Haven—Power Equip. & Serv. Co.
GEORGIA, Atlanta—R. S. Armstrong & Bros.
ILLINOIS, Rockford—Standard Road Equipment Co.
Peoria—The A. E. Hudson Co.
Springfield—Miller & Requarth.
IOWA, Des Moines—Dukehart Machinery Co.
KANSAS, LaCrosse—F. E. Vaughn.
Salina—Salina Trac. & Thresher Co.
KENTUCKY, Frankfort—Frankfort Equipment Co.
LOUISIANA, New Orleans—Louisiana Road Mch. Co.
MAINE, Portland—Eastern Tractor Co.
MASSACHUSETTS, Cambridge—Eastern Tractor Co.
MICHIGAN, Lansing—Hubbard Equipment Co.
MINNESOTA, St. Paul—Borchert-Ingersoll, Inc.
MISSOURI, St. Louis—O. B. Avery Co.
Springfield—R. L. McDonald Equip. Co.
MONTANA, Butte—Hall Perry Machinery Co.
NEBRASKA, Omaha—Interstate Mch. & Supply Co.
NEW MEXICO, Albuquerque—Morrow Auto Co.
NEW YORK, New York—Good Roads Mch. Co. of NY, Inc.
Penn Yan—W. H. Stoutenburg.
NORTH CAROLINA, Asheville—Asheville Sup. & Fdry. Co.
Raleigh—North Carolina Equip. Co.
NORTH DAKOTA, Fargo—Lewis Tractor & Mch. Co.
OKLAHOMA, Enid—Bert Smith.
Oklahoma City—Herd Equipment Co.
OREGON, Portland—Feenaughty Machinery Co.
TENNESSEE, Memphis—W. D. Banker Road Mch. Co.
Nashville—Tennessee Tractor Co.
TEXAS, San Antonio—Lewis-Patten Co.
Houston—The R. B. Everett Co.
UTAH, Salt Lake City—C. H. Jones Co.
VIRGINIA, Richmond—Richmond Machy. & Equip. Co.
WEST VIRGINIA, Huntington—Banks Miller Sup. Co.
Welch—Welch Good Roads Sup. Co.
WISCONSIN, Milwaukee—Badger Trac. & Equipment Co.



Levels Earth . . Gravel . . Stone and Retread Roads

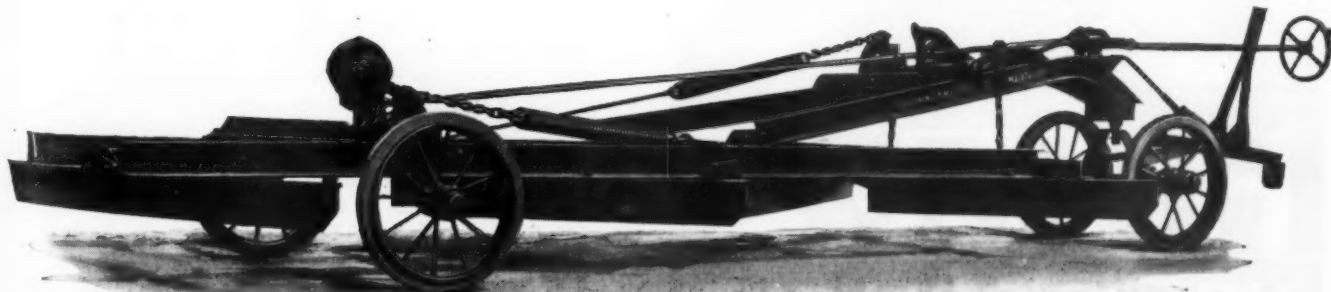
Road maintenance is reduced to a simple task with the Galion Multiple Blade Maintainer. Seven blades pass the road material back and forth across a nine foot cut, four times in a single trip, cutting off the high places, filling the holes and leaving a smooth accurately graded road.

Operator of power unit also operates the Maintainer by means of a single control handwheel which is conveniently accessible from his tractor seat. For retread work separate seat and control provide for individual operation.

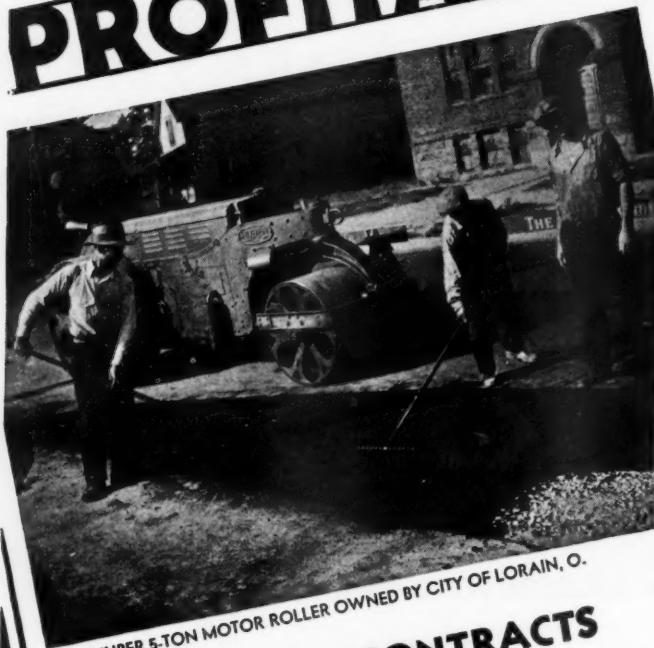
Furnished with 8 inch blades for general maintenance service or with 12 inch blades for mulch or retread work. Blade extensions can also be furnished to increase cutting width up to 12 feet.

Write for Bulletin No. 107 which describes the many important operating and construction features of this Maintainer.

The Galion Iron Works & Mfg. Co.
GALION, OHIO



PROFITABLE

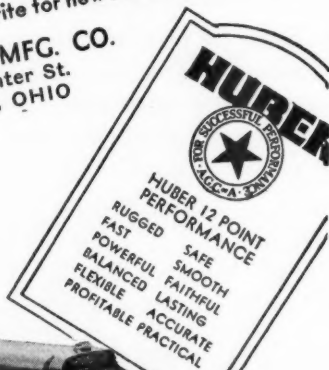


HUBER 5-TON MOTOR ROLLER OWNED BY CITY OF LORAIN, O.

WIN MORE CONTRACTS WITH HUBER

WITH a new Huber on the job, you can land contracts that call for quick action. A Huber blade they smooth off the rough places and the rolls compact loose materials. The Huber 10 and 12-ton sizes with sprinkler attachments are widely used for rolling hot asphalt pavements. Built from 5 to 14 tons. Write for new Huber Catalog.

THE HUBER MFG. CO.
345 E. Center St.
MARION, OHIO



HUBER

MOTOR ROLLERS

When writing, please mention PUBLIC WORKS

With Our Authors



DON M. HOFFMAN, author of our leading article this month, was born in Stockton, Calif., in 1898, where he attended grade schools, subsequently going to Berkeley to take up architecture, but to finish finally in Civil Engineering. He got into the World War (like a good many others did), serving in the 27th, 29th and other outfits. He still retains his touch with those olden days, and is now a Captain in the CWS-Res. (which translated means that he is a reserve officer in the Chemical Warfare Service). He entered the Government service with the War Department, Topographical Mapping Division, and passed thence into the Engineering Department of the Forest Service, where he spent 10 years with the Maps and Surveys, Federal Power, and Forest Highways Divisions, on location and construction. He left this position to take the position of Branch Manager of the Edward R. Bacon Co., a large western equipment firm operating in California and Nevada. Mr. Hoffman is now located at Sacramento. He is a registered Civil Engineer, and Associate Member of the A. S. C. E. and a Member of the Society of American Military Engineers.

MORRIS M. COHN—Where have we heard that name before? Who is he? What does he look like? Where and why does he hide like a shrinking, modest violet? Why not his picture here?

Morris is the "Six-Star Sporting Final" of our contrs. As irrespressible as the gas vents of his own Imhoffs, which he pets and fusses with down along "The Mohawk Vale," he is known far and wide, wherever sewage flows down to the creek, branch, crick, brook, river, or what have you. It was he who set the fashion some years ago by being *interred* alive in one of his own settling tanks; but he emerged again, on better terms than ever with the w.k. and h.i. bacteria which infest such places. He won't send his picture, but he's going to be with the readers of PUBLIC WORKS from now on, telling in his own inimitable way how he flim-flams the poor farmers into paying real money for sludge (and makes them like it), how through his efforts honored guests of the City of Schenectady are now presented with the freedom of the sewage plant instead of the freedom of the city, and how the children going home from school, look in at the open door to watch his trained bacteria perform. And like the above-mentioned folks, you're going to enjoy and profit by what Mr. Cohn has to say. Back of his ability to put out readable, interesting and amusing stuff, he has a real story to tell, a real point to make, and the knowledge of how to put over valuable information in a new and refreshing way. He has one of the keenest minds in the business, and as much "It" as you'll find in a long journey. Oh, yes, he is in charge of sewage treatment for the city of Sch—Sch—(why doesn't he move to Troy or Rome) Schenectady, N. Y., and has been with that city ever since he graduated from Union College some ten years ago. Greetings, Morris, we're sure glad to have you with us.

FRANCIS E. DANIELS, born in Maryland, 1872, was graduated with degree A. B., at St. John's College, Annapolis, Md., 1891; A. M. 1893. He was a member of the Faculty of St. John's College, as assistant Professor and later Professor of Mechanical Engineering, Botany and Biology from 1893 to 1906. A special and graduate student at the Massachusetts Institute of Technology in courses in Public Health, Bacteriology, Chemistry, Vital Statistics, Sewage Treatment, Water purification, general Sanitary Engineering and special research, 1906-1908.



He was with New Jersey State Department of Health, as Chemist and Bacteriologist and later Chief, Division of Sewage and Water Supplies, 1908-1916; and has been with the Department of Health of Pennsylvania as Assistant Engineer, Chief, Chemical Laboratory and Chief, Industrial Waste Section, Bureau of Engineering 1916 to date.

He is author of book on *Operation of Sewage Disposal Plants*, and numerous articles in technical journals.

He was a captain, Sanitary Corps, U. S. Army 1917-1919, serving as Sanitary Engineer at Camps Greene and Lee. Major with Certificate of Capacity for promotion to Lt. Col., Sanitary Corps, U. S. Army Reserve, 1924 to date.

(Major Daniels is a charter member of the Order of the Boar, and has been an important factor in the instruction in Military Sanitation at Carlisle Barracks, Pa.—Ed.)

LAWRENCE L. LUTHER is manager of the Department of Sanitation of Freeport, N. Y. That's a nice sewage treatment plant he has. EARL FELDMAN is County Surveyor of St. Joseph County, South Bend, Ind. W. H. ROOT is maintenance engineer of the Iowa State Highway Commission. E. C. GARVIN, city manager of Brunswick, Ga., is the author of the article appearing on page 40, and describing refuse disposal and street cleaning in Brunswick. A short sketch of Mr. Garvin's career appeared in the August, 1930, issue of PUBLIC WORKS.

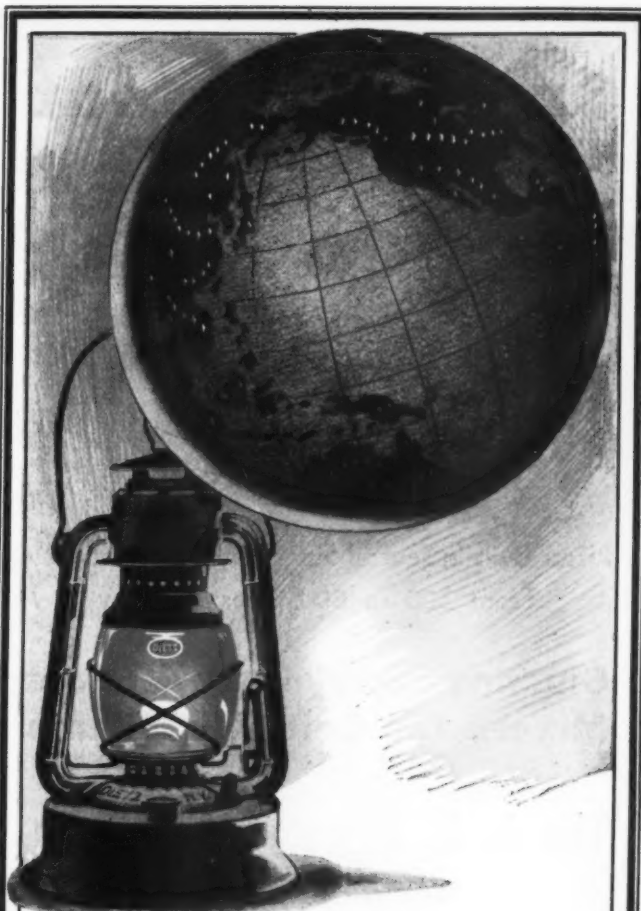
FROM THE CLIPPING BUREAU

Ropy Milk Caused by Impure Water

A milk dealer in one of the cities of New York State lost about 60 per cent of his patronage within a period of four weeks as a result of "ropy" milk. It was thought that mastitis among the herds or improper diet was the source of the trouble, and a number of cows having diseased udders were eliminated and the cattle in several pastures were removed to different fields, but the condition persisted.

At the request of the county commissioner of health, one of the field men of the State Department of Health investigated the situation. His first step was to strain through cloth the milk received from each of eight farmers who supplied the plant. In two instances, the strainer became so clogged with ropy accumulations that it ceased to function.

A visit to the two farms on which the supplies in question were produced revealed that, owing to a severe water shortage, the owners were using water from open springs surrounded by swampland, and



DIETZ RED LANTERNS Dot the Highways of the World

Use
RED!
No
other
color
means
danger

TRAVEL the world over and you will find Dietz Lanterns dotting the roadsides at night — their faithful beams peacefully defying the gales and storms of every land — their red lights flashing universal danger signals, instantly understood in all languages.

The superior lighting power and burning dependability of Dietz lanterns affords lowest cost protection to traffic and contractors alike. You cannot afford to risk use of warning lights less tried and true.

R. E. DIETZ COMPANY
NEW YORK

Largest Makers of Lanterns in the World

FOUNDED 1840



Cummer Patent DRYER-COOLER

For Cold Mix Plants

Continuous Process No Silos

Stone Delivered From Dryer Thoroughly
Dried and Cooled

Plants Built in Several Sizes Ranging in Capacity
From 300 to 600 Tons Per Day

**Cummer Heavy Duty 40 Foot
Mixers for Cold Mix Plants**

The F. D. Cummer & Son Co.
Cleveland, Ohio

DETROITER


SINGLE ROOMS
WITH
PRIVATE BATH
\$2.⁰⁰
\$3.⁰⁰
NO HIGHER

HOTEL

ROOMS 750 BATHS

FREE GARAGE

UNDER KNOTT MANAGEMENT



DETROIT

transporting it for domestic and cooling purposes in milk cans and pails. As organisms causing "ropiness" have been found in surface waters, immediate discontinuance of the use of the two springs was recommended. The producers were advised to cleanse thoroughly and sterilize all milking equipment and cooling apparatus, to wash the walls of the milk rooms with chlorine solution, to keep the cows clean and for several days to wash their udders with a disinfecting solution half an hour before milking. The milk dealer was also advised how to sterilize every piece of equipment and all utensils used in his plant as well as how to disinfect the floors and walls. The trouble subsided promptly after application of these measures.

Sneeze Causes Knockout

According to New Jersey Public Health News, sneezing at the wrong time resulted in the collapse and three weeks illness of the sewage plant operator at Red Bank.

A leak in the chlorine line between the container and dosing apparatus had allowed large quantities of fumes to collect in a room. The operator entered the room without a gas mask, intending to hold his breath and turn off the gas. Then he had to sneeze, and in the next moment filled his lungs with chlorine and "passed out."

Associates dragged him from the room, but a week in bed and two weeks convalescence was the price of that sneeze.

This man will not neglect the gas mask next time,

Contractors or Would-Be Contractors

"The Scraper," published by the Kentucky Association of Highway Contractors, contains the following in its issue for March 27th, anent the 124 bids received March 11th from 57 bidders for work in Kentucky:

"The item of 'unclassified excavation' appeared for the first time in this letting in the place of the items 'common excavation' and 'solid rock excavation.' About the lowest bids formerly received on common excavation and solid rock excavation were 25c and 60c respectively. But, believe it or not, bids were submitted in this letting on unclassified excavation at 26c on a job on which there will be considerable solid rock excavation, and 29c on a job on which there will be from 30% to 60% solid rock excavation. You may judge for yourself as to whether or not such bids were submitted by contractors or *would be* contractors.

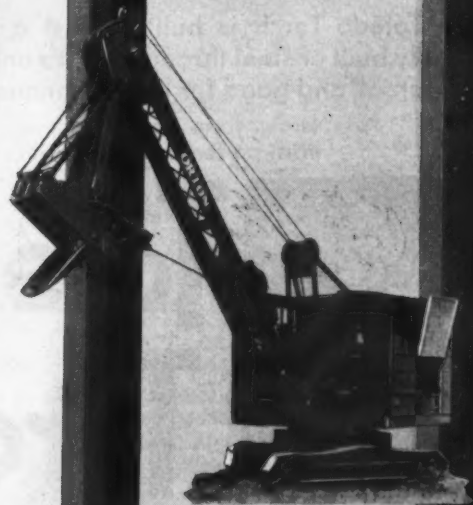
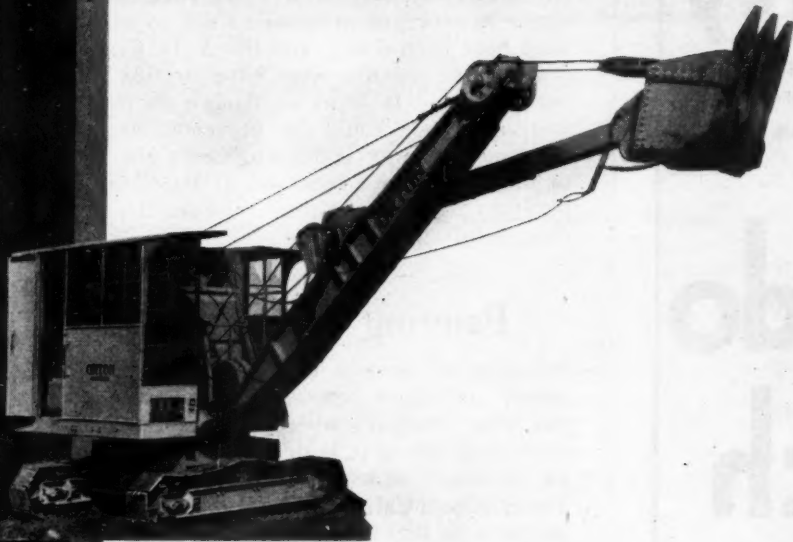
"Bids for the removal of a bridge on one project ranged from \$25 to \$2500. The bids for the construction of a temporary bridge on this same project ranged from \$25 to \$3000. Some careful thought was certainly given those items by the bidders. Needless to say, the \$25 bids were part of the low bid for the whole job.

"Concrete paving on one project was bid as low as \$1.32.

"Come on in you out-of-state boys. If you can ship in for nothing you may be able to save railroad fare back home provided you turn over your equipment to the sheriff here before you leave.

Outstanding Value

In a Half-Yard Machine



HERE is the utmost value in a convertible half-yard excavator. Every part is designed to withstand the hard knocks to which a small machine is subjected. Base, turntable and boom heavily constructed and completely electric welded. Large-diameter power shafts of heat-treated chrome alloy steel.

Speed and ease of operation also are features of the Model 4. Accelerator controlled 40-hp. gasoline engine equipped with variable-speed transmission. Fast hoisting, swinging and crowding enables this machine to make five trips a minute in regular operation. Travels $\frac{5}{8}$ to 3 miles an hour, and will climb a 25 per cent grade.

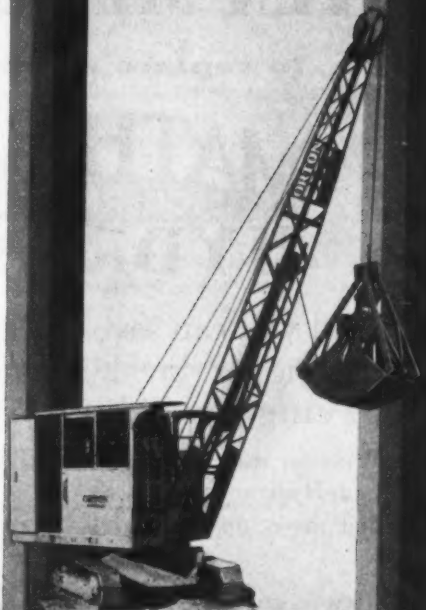
Write for prices and complete information.



**ORTON CRANE
& SHOVEL CO.**

608 S. Dearborn St., Chicago

Representatives in Principal Cities



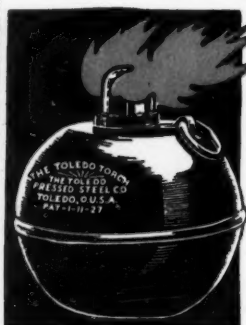
ORTON

Cranes. Shovels & Buckets

Durability

The Toledo Torch is built to last a long time. Rigidly built of steel throughout, it's unbreakable, leakproof and good for long, continuous service.

Order from your dealer—
insist on the genuine Toledo



Toledo Torch



The Toledo Pressed Steel Co.
TOLEDO OHIO

Save with Steel

Manufacturers of The Toledo Horse—the ideal highway barricade

TEN MINUTES

to replace a broken

MATHEWS MODERNIZED HYDRANT

Reg. U. S. Patent Office

And you can save the expense of digging or breaking the cement paving in which it is set.

Write for the new, illustrated Mathews Modernized Hydrant booklet which gives all the details and shows an actual replacement being made.

R. D. WOOD & CO.

In business continuously since 1803

400 Chestnut St. Philadelp^hia

CAST IRON PIPE AND FITTINGS

SAND SPUN (centrifugally cast) and PIT CAST

Reg. U. S. Pat. Off.

GATE VALVES

"It certainly takes an expert to figure out such bids as some of those submitted in this letting, but it looks like all the troubles of the construction industry will be with us until these experts (?) are killed off by starvation and bankruptcy, and no doubt by that time a new crop of experts (?) will be coming along."

Few highway or municipal officials desire to let contracts that do not promise a reasonable profit to an experienced contractor. Many of them time and again have urged contractors not to bid so low as some have been doing, and the A. G. C. A. and state contractors' organizations have argued and cussed, but in vain. It looks as though the only way the foolish bidders could be prevented from throwing their money away is for engineers and departments to refuse to award contracts at bids less, by say 25 per cent, than the engineer's estimate, or than the average of all the bids.

Painting Creosoted Wood

Creosoted wood is used extensively for posts for guard and other fences, for wire-supporting poles, and other purposes where it is especially subject to decay and where it is desired to paint it. But most paints cannot be used successfully on creosoted wood. The Southern California Edison Company has adopted the plan of nailing untreated strips vertically on its poles along one of the state highways and painting these white, but this is expensive.

About two years ago experiments were tried, using four commercial paints: a white paint, a green lead base, a green zinc base, and an aluminum paint. These were applied to creosoted poles which had been set in the ground and allowed to dry out for about three weeks before painting. Within 60 to 90 days the first three paints had begun to show discoloration. At the end of two years the white paint was almost entirely obliterated, while the green lead base paint showed only streaks of the original color, and the zinc base paint was the same. In all three the paint formed a smooth, dry surface, but the color of the creosote prevailed. The aluminum paint had not discolored but kept its bright silver finish. It can be used as a priming coat for other paints if desired.

In using aluminum paint, the wood should dry at least three or four weeks after being creosoted. The Aluminum Company of America suggests the following for mixing aluminum powder for painting creosoted material: "The vehicle should be a hard dry long oil, varnish type, containing 50% by weight of non-volatile oils and gum. The ratio of the oil to gum should be approximately three to one (in other words, about a forty-gallon varnish). The major portion of the vehicle should consist of heat treated China wood oil, and the remainder heat treated linseed oil. It should set to touch in about two hours and dry hard in twelve hours. It should have highly efficient 'leafing' qualities when mixed with 2¼ pounds of Standard Varnish Albron per gallon. The paint should be mixed on the job and used very promptly."

Since the starting of these experiments the Oklahoma State Highway Department has been painting creosoted posts with aluminum, and the Kansas State Highway Department adopted similar practice the past year. The Texas State Highway Department more recently painted some of their highway posts in this manner.

PUBLIC WORKS

An Engineering and Construction Journal

City

County

State

VOL. 62

MAY, 1931

NO. 5

TABLE OF CONTENTS, MAY, 1931

Frontispiece	Courtesy U. S. Bureau of Public Roads	
Bridges		
Principles of Design of Steel Highway Bridges. <i>By Earl Feldman</i>		26
Construction Equipment		99
Contracting		
Contractors and Would-Be Contractors.....		8
Operating Motor Trucks Profitably in Contracting.....		24
Editorial		33
General		
Painting Creosoted Wood.....		10
Highways and Pavements		
Construction of a Low-Cost Pavement in Grass Valley, Calif. <i>By Don M. Hoffman</i>		19
A Truck for Road Maintenance.....		23
The Tractor for Road Maintenance Work. <i>By W. H. Root</i>		27
Highway Policies in Several States.....		37
Bituminous Surface Treatment Methods.....		48
Highway Construction in the 48 States.....		51
How Will the Volume of County Highway Work in 1931 Compare with that of 1930?.....		54
Recent Legal Decisions. <i>By John Simpson</i>		55
Sewerage, Sewage Treatment and Drainage		
Sneeze Causes Knockout.....		8
Sewage Treatment Plant of Freeport, N. Y. <i>By Lawrence L. Luther</i> ...		21
Where's the Sewage Works? <i>By Morris M. Cohn</i>		29
The Practical Operation of Sewage Disposal Plants. <i>By F. E. Daniels</i> ...		59
Drains Laid on Soft Soil.....		64
Removing Sludge from Drying Beds		90
Street Cleaning and Refuse Disposal		
First Installation of Standard Accounting and Recording Forms....		35
Refuse Disposal and Street Cleaning at Brunswick, Ga. <i>By E. C. Garvin</i>		40
Preventive Street Cleaning.....		41
Water Supply and Purification		
Ropy Milk Caused by Impure Water.....		7
Rapid Installation of San Francisco Emergency Supply.....		23
Cambridge Installs More Efficient Pump.....		28
Romance of Engineering in the Philippines.....		31
The Water Wheel. <i>By Jack J. Hinman, Jr.</i>		44
Effect of the Drought on Maryland Water Supplies.....		72
With the Authors		4

How Much Work:

In this issue will be found reports from about 600 counties telling how much work they plan this year as compared to last year. A drop of 8.8%, considering the lower prices for construction work this year, means more county highways than ever will be built this year. We'd like to hear from some of the county and city engineers how much prices in their vicinity have fallen. Please send the data on this to THE EDITOR, PUBLIC WORKS, 310 E. 45th St., N. Y.

Try This On Your Transit

Some two or three years ago, in the *Saturday Evening Post*, appeared this problem, which we think will afford about the best possible exercise for our mathematicians, who have had a right considerable rest now. It seems that five men and a monkey were cast off on an island which yielded nothing but cocoanuts. In fear of starvation they worked hard and gathered a large pile of cocoanuts. But they didn't trust each other and decided to divide them evenly in the morning. One of the men, still uncertain as to the intentions of the others, however, kept awake, and when the others (presumably) had gone to sleep he got up, divided the pile into five equal parts and had one coconut left over, which he gave to the monkey. He then hid his pile, mixed the other four piles together and went back to sleep. A little later another man, moved by the same feeling, got up and did likewise. He, too, had an extra one, which he gave to the monkey. A little later the third man did the same; and the fourth man, and the fifth man, each donating the extra one to Mr. Monk. In the morning all could see that something serious had happened to the pile of cocoanuts, but, being equally guilty, no one said anything. The pile was then divided equally among the five, there being no odd one for the monkey in this case.

How many cocoanuts were there to begin with?

Why Editors?

We ran into this the other day in the course of peregrinating through a rather recent highway textbook: "The purpose of reinforcement (in roads) is to hold the cracks together." Quite so.

Eh, What?

One might almost call that stuff mentioned on page 97 *High Speed Hypo*. Getting so poor old *B Typhosus* isn't safe, even way back among the rhubarbs, so to speak.

J. T. MORRIS
President

W. A. HARDENBERGH
Vice-Pres. & Asso. Editor

CROXTON MORRIS
Ass't Manager

PUBLIC WORKS

Founded in 1896

A. PRESCOTT FOLWELL, Editor

Published Monthly

at 310 East 45th St., New York, N. Y.

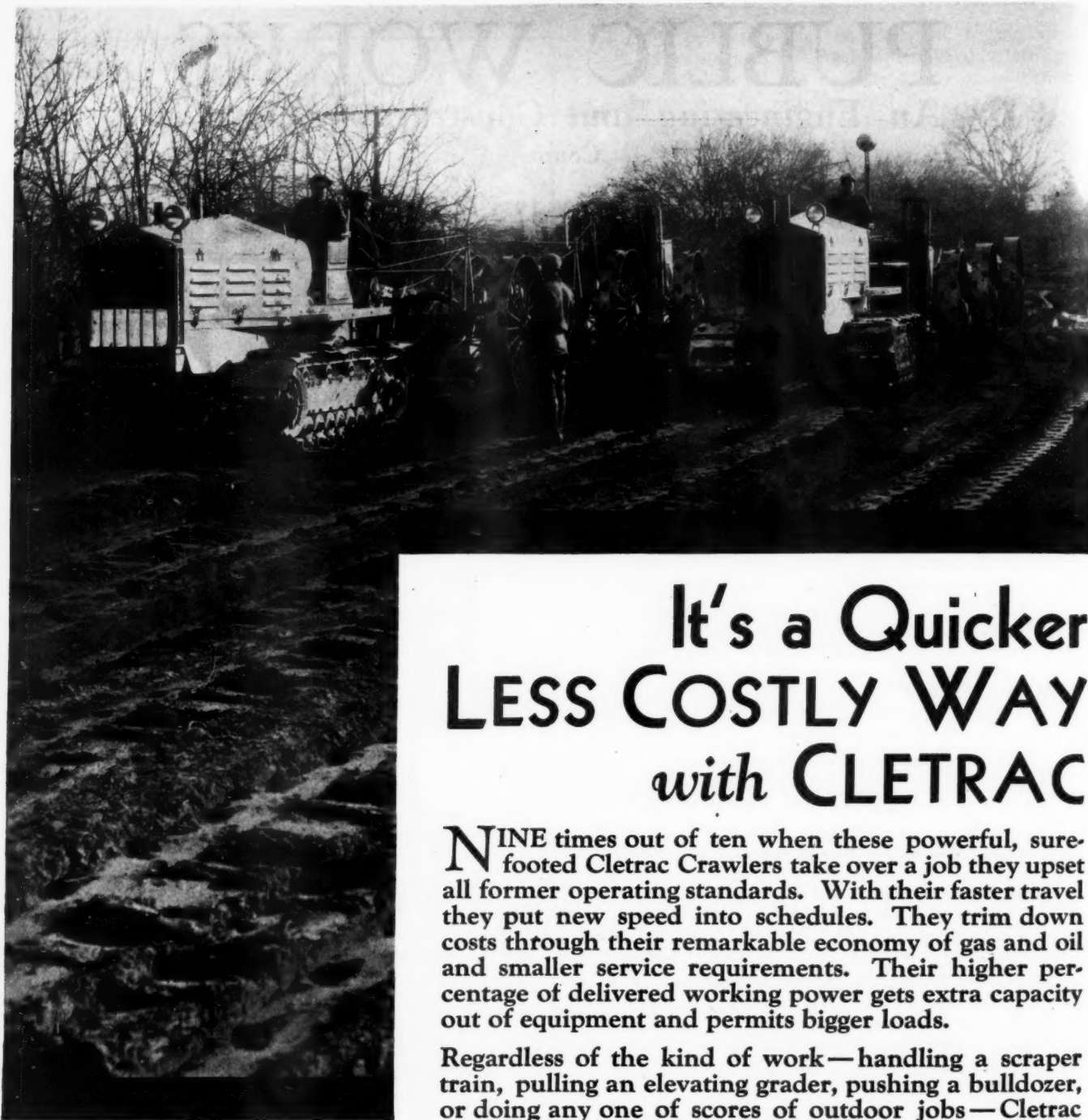
Western Office: 122 South Michigan Ave., Chicago

S. N. HUME
Cleveland, Ohio

JOSEPH E. O'CONNOR
Chicago, Ill.

SUBSCRIPTION RATES: United States and Possessions, Mexico and Cuba.....\$3.00

All other countries.....\$4.00 Single copies, 35 cts. each



Cletrac Crawlers are built in a complete line of five sizes with deliveries of from 15 to a maximum of 80 horsepower.



It's a Quicker LESS COSTLY WAY with CLETRAC

NINE times out of ten when these powerful, sure-footed Cletrac Crawlers take over a job they upset all former operating standards. With their faster travel they put new speed into schedules. They trim down costs through their remarkable economy of gas and oil and smaller service requirements. Their higher percentage of delivered working power gets extra capacity out of equipment and permits bigger loads.

Regardless of the kind of work—handling a scraper train, pulling an elevating grader, pushing a bulldozer, or doing any one of scores of outdoor jobs—Cletrac Crawlers put new vim and vigor into the operation and save a great many dollars in a season's time.

Cletrac Crawlers are built for rough going and tough tasks. They handle easily with their simplified controls and patented planetary gear steering. All models have automatic lubrication which does away with daily hand oiling and greasing and safeguards the tractor against neglect or service oversights.

Get in touch with a Cletrac dealer for a demonstration and first hand facts about these better tractors — or write direct for literature and information.

THE CLEVELAND TRACTOR COMPANY
19322 Euclid Avenue CLEVELAND, OHIO

PUBLIC WORKS

CITY

COUNTY

STATE

AN ENGINEERING AND CONSTRUCTION MONTHLY

Vol. 62

May, 1931

No. 5

Construction of a Low-cost Pavement in Grass Valley, California

By Don N. Hoffman

Sales Engineer, Edward R. Bracon Co.

THE City of Grass Valley located on the western slopes of the Sierra Nevada range, has a population of 3,810 people. The 1929 tax rate was \$1.40 and the average income from all sources is about \$58,600 annually.

Of the twenty miles of streets within the corporate limits maintained by the city, about ten miles are paved with portland cement concrete, for a width of 18 feet except on the several main business streets, which are paved for their full width. The concrete pavements were constructed by contract, from money obtained through a bond issue some years ago. The remaining streets of the city are graveled and earth roads, and, due to the

comparatively heavy precipitation coupled with the hilly topography, maintenance of these streets has always been a considerable expense and labor. Each year it has been necessary to respread gravel, shape up the streets by grader and tractor, and maintain a patrol in places, in order to allow ordinary travel in stormy weather. During the summer months, sprinkling has been necessary to lay the dust.

Because of the limited finances available, as well as the lack of an organized engineering department (which is common to practically all cities of this size), the City Board of Trustees, of which M. J. Brock is chairman and mayor, undertook to determine meth-

ods and costs of modern street improvements, with the general reconstruction of their own city streets in mind. All members of the board believed that only a first-class type of hard-surface street would be acceptable. After visiting various cities where work was being done along similar lines and making a general survey of street conditions and improvements as

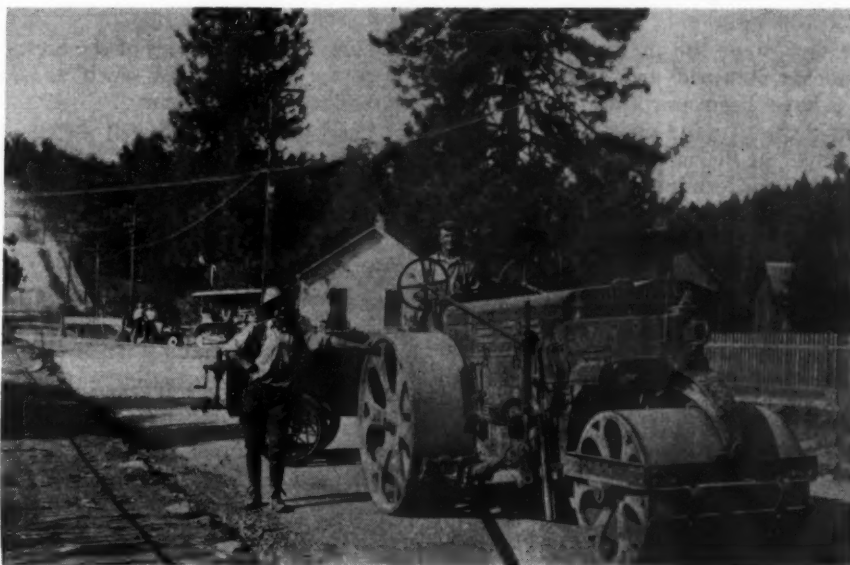
applied to cities of about the same size as Grass Valley, the board adopted a penetration type of asphalt macadam.

Improvements Made

Many of the streets, graveled and highly crowned to facilitate run-off of rain water, have an excellent sub-grade of thoroughly compacted base rock, consisting of graded

material from 2½" to dust, which has been applied from year to year by the street department. Other streets have required laying of a base course before further improvement was possible. In many cases it was found that added improvement was possible by removing bad intersections and laying culvert pipe, and in some cases additional width of roadway was obtained by re-aligning fences and pole lines. Every effort was made to look as far ahead as possible.

On the streets that already had been graveled, a light cut with a scarifier was made to a depth of about 2 inches, which very effectively broke up the hard bones of cemented material and eliminated the ruts and



Second course of rock in place and rolled, prior to final penetration coat of asphalt and top course of screenings.

washboard conditions without penetrating below the thickness of the base rock. In this manner the compacted original subgrade was retained, which was much desired. The road metal was then bladed to the sides with a 7 ft. blade grader and "30" Caterpillar tractor, and the gutters shaped up where concrete gutters were not already in place. The loose material was then respread back over the street and additional base rock added to bring low places up to the desired level. Water, which was obtained readily from residences along the streets being improved, was used when necessary, and the subgrade was then thoroughly rolled with a Huber 5-ton 3-wheel roller of the latest 4-cylinder type, with 18" rear rolls exerting a pressure of 225 pounds per square inch of surface.

After the subgrade had been compacted thoroughly by rolling and showed an even and unbroken profile, a first course of clean, crushed rock, from $1\frac{1}{2}$ " to 1" in size, was spread to a depth of about $2\frac{1}{2}$ inches and rolled until further compaction appeared impossible, and was then ready for the first application of hot asphalt.

The base course was given a spray coat of hot asphalt at a temperature of from 275° to 350° F., the surfaces of the rock being well covered by about $\frac{3}{4}$ gallon per square yard.

A 95% grade E asphalt was used throughout the work, applied under pressure with the use of a Model T Mohawk "Hotstuff" asphalt heater, which had a storage capacity of 100 gallons of asphalt (two barrels). Due to the design of the melting chamber, a rapid heating action is obtained and as many as 16 barrels of asphalt have been put through this machine in one 8-hour day. A hand-operated gear pressure pump is mounted on the machine and a flexible 15-foot metal-covered hose terminates in a spray nozzle. The fuel used is ordinary kerosene, which is kept under air pressure by a simple pump.

After the asphalt had been applied to the first course of $1\frac{1}{2}$ " rock, the roadway was immediately covered with an application of $\frac{3}{4}$ " key rock, hauled to the job in a Ford 1-yard dump truck and backed onto the grade as the spreading progressed. All spreading was done by hand and effort made to thoroughly cover the grade with about 1 inch of this size material in an even layer. The roller was again put to work and the second course of rock brought to a smooth, even cross section. Rolling is by far the most important operation in this type of surfacing, and

thorough compaction must be obtained. Some hand spreading and brooming must be done to get a proper finish to the work and to remove whatever fine material appears on the surface.

The second course of rock, after rolling, was given a coat of hot asphalt through the Hotsuff heater and immediately covered completely with sharp, clean screenings from crushed rock of from $\frac{1}{8}$ " to $\frac{1}{2}$ " size. This top course of rock was evenly spread, and rolling was then started and continued until a hard, smooth surface was obtained. Where required, additional screenings were applied to cover any appearance of asphalt, and the following day the road was opened to traffic. On some stretches the superfluous screenings were broomed ahead to the side of the roadway, but usually the surface was left as the roller completed it.

Organization and Equipment

The success of this work is, in a measure, more striking when the organization is noted. A crew of 6 men did the work under the direction of the superintendent of streets, George Bennetts. The program was laid out with this size crew in mind, and the progress has been very satisfactory.

The crew employed consisted of:

- 1 Tractor operator, who also operated the roller;
- 1 Truck driver, who attended to loading rock, etc.
- 2 Long term men, who operated the asphalt heater, etc.
- 2 Temporary laborers.

The various members of the crew also did such other work as was required, such as scarifying, blading, spreading and watering.

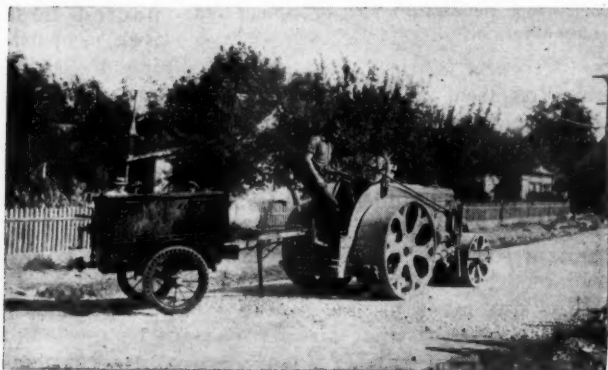
The equipment consisted of:

- 1 Thirty "Caterpillar" tractor.
- 1 7-ft. blade grader.
- 1 5-ton Huber, 4 cylinder motor roller with smoothing blade attachment.
- 1 Model T Mohawk "Hotstuff" asphalt heater, with hand pressure pump, 100-gallon size.
- 1 Scarifier.
- 1 Ford 1-yard dump truck.

Rate of Progress and Cost

It has been found that the above crew of 6 men, using the equipment listed, can lay approximately 2,000 square feet of completed pavement per 8-hour day. This amounts to about 100 lineal feet of twenty-

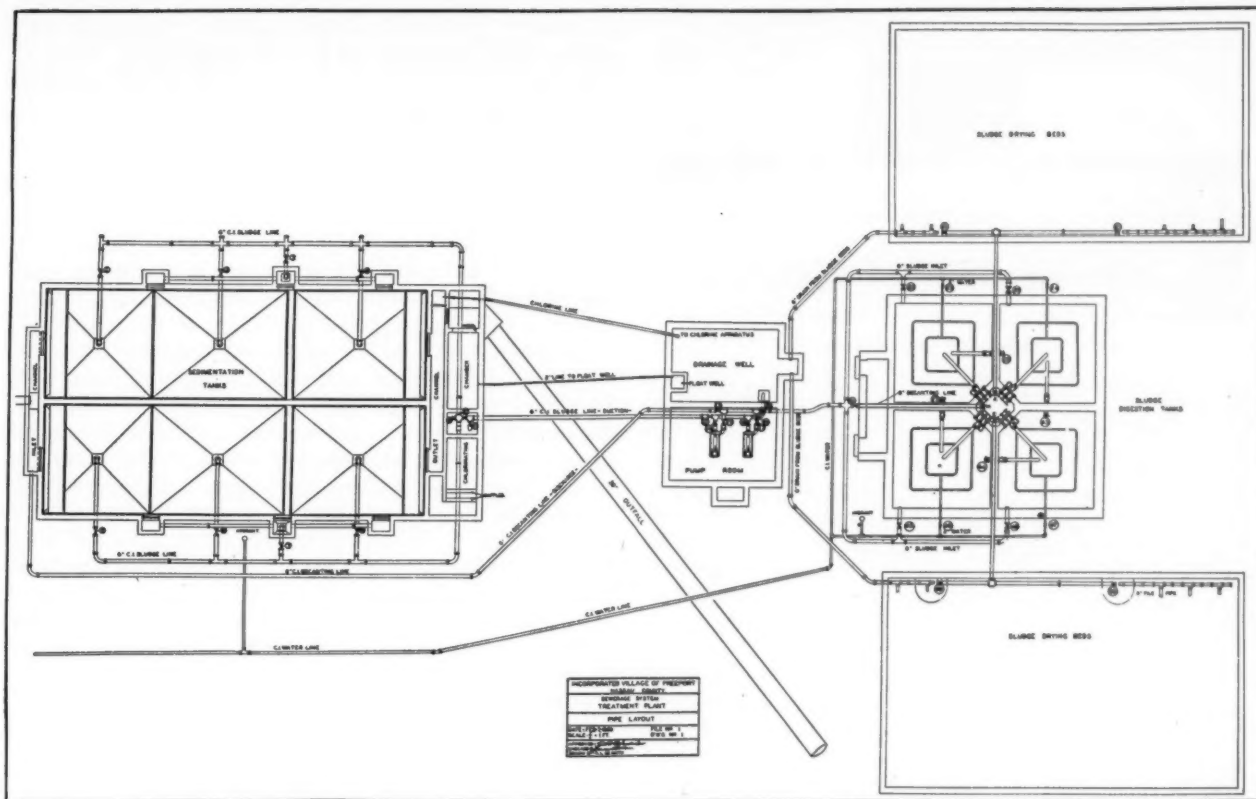
(Continued on page 63)



Showing first, second and top courses of rock; compacted subgrade in foreground, roller and heater.



Final result—an excellent surface with smooth, even, low crown.



General plan of Freeport's sewage treatment plant

Sewage Treatment Plant of Freeport, N. Y.*

By Lawrence L. Luther
Manager, Dept. of Sanitation, Freeport, N. Y.

THE incorporated village of Freeport, situated in Nassau county on the south shore of Long Island, contains 19,475 persons, 5,281 residences and buildings, 289 stores and 47 public buildings.

The necessity of a sanitary sewer system was considered in 1912, but not until 1926 were any definite steps taken in the matter.

Today, Freeport has a total of 38.5 miles of sanitary sewers varying in size from 8" to 27"; a modern disposal system consisting of pumping station, treatment works, outfall sewer and force main. The entire village will be sewered in the very near future.

The present design provides for a contributory population of 42,000 people with a maximum flow of 250 gallons per capita per day. The trunk sewers are designed to carry this flow when running 0.7 full and the lateral lines when running 0.5 full. This per capita allowance for the maximum flow is high, but it is considered a reasonable one when the ground water conditions are taken into consideration, although the present water consumption in the village is about 68 gallons per capita. It is estimated that the trunk sewer has capacity sufficient for at least twenty years.

There are at present approximately twenty-eight miles of 8-inch and 10-inch laterals, reaching prac-

tically all the business and apartment house areas and a large part of the residential sections.

Clyde Potts, consulting engineer of New York, and Baldwin & Cornelius Co., Inc., of Freeport, were the designers of what we term the comprehensive district system.

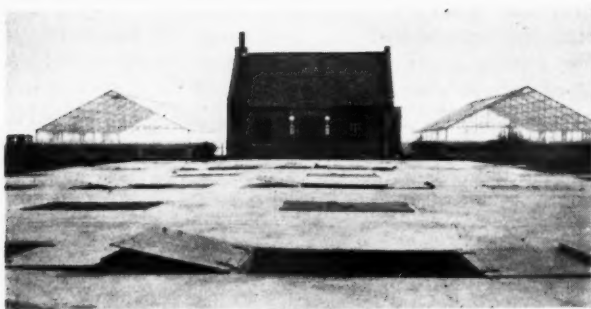
Pumping Station

The pumping station consists of electric motor driven pumps automatically operated, installed in three separate units, each unit of 1½ million gallons capacity. A concrete storage well of 30,000 gallons capacity is installed beneath the pumping station to balance the flow of sewage without backing up the sewage into the main sewers above the normal flow line.

The piping, valves, etc., are installed to take care of a flow of ten million gallons per day, corresponding to a maximum flow of 250 gallons per capita for a population of approximately forty thousand persons. The pumps in use at present will take care of the flow from a connected population of from ten to twelve thousand; they can be replaced with large ones when the time comes, without interrupting the use of the pumping station.

The pumps are placed underground but are easily accessible. They are driven by 15 horsepower motor; and are automatically controlled by the level of the sewage in the suction well, a second being cut in :

*Paper read to the New York State Sewage Works Association.



Sewage treatment plant

the first can not keep the level down, and a third if the level continues to rise and reaches a predetermined level. The order of the pumps is changed daily so that, at this time, no one pump is used continuously. The superstructure is built of brick and presents a very attractive appearance. The grounds are planted with shrubbery and the passing public often wonders just what the building is. In fact, on more than one occasion we have had inquiries from strangers as to whether the village wanted to rent that little brick building for a gasoline station.

The operation of this station is practically automatic. One operator visits it three times a day to clean off the bar screens, oil the motors, etc. All screenings are trucked to the municipal incinerator and burned daily with the refuse. There are no odors, noises or other unpleasant features. In fact, we feel that it enhances the value of the surrounding properties.

The sewage is pumped to the treatment plant through a 24" reinforced concrete main approximately one mile in length.

Treatment Plant

The treatment plant consists of reinforced concrete settling tanks, chlorinating chamber, concrete sludge digestion tanks, and two glass-covered sludge drying beds. The immediate construction is built to take care of a connected population of approximately 10,000 persons. Extensions can be made from time to time as required without interruption to the plant. The capacity of the plant is based upon an estimated average flow of 125 gallons per capita and a maximum flow of 250 gallons per capita.

The settling tanks, which have a combined area of approximately 50 x 60 feet, are placed underground, constructed in two units, with a capacity sufficient to give a detention period of four hours with five per cent additional capacity for sludge storage. They are covered with a concrete cover with sufficient iron doors to make skimming, etc., easy. Sludge is removed from the hopper bottoms through 6-inch sludge pipes and pumped into the digestion tanks. The settled sewage passes into the chlorinating chamber, where chlorine is applied. After a detention period of approximately thirty minutes, it passes over a V-notch weir to the 30-inch outfall sewer, which terminates about 2,500 feet from the plant, at a manhole connected to a 24" cast iron pipe equipped with four 24" x 12" diffusers, which empty into Freepoint creek.

The sludge digestion tanks are placed partly above ground, and are covered with a concrete roof with necessary openings. Their capacity was calculated on the basis of 4.5 cubic yards of sludge per million gallons and a detention period of 150 days, which

amounts to 2.3 cubic feet per capita. The tanks are in two units covering an area of about 25 x 55 feet. The liquor is decanted and returned to the settling tanks. The sludge remains in the digestion tanks for about three months, and is then removed by gravity to the sludge drying beds.

There are two glass-covered drying beds, with a total area of approximately 5,000 square feet, providing one-half square foot per capita. These were constructed by the Lord & Burnham Company and are of their standard design. They consist of 4 to 6 inches of sand laid on 10 inches of broken stone. Tile drains with open joints are laid beneath the stone and the liquor returned to the drainage well under the head house and thence pumped through the decanting line back to the settling tanks. When sludge is dry and ready for removal, which varies from six to ten days in good drying weather, it is removed by hand from the beds. Ample provision is made for its removal.

A brick building 25 x 30 feet, known as the head house, houses two gasoline-driven sludge pumps, chlorinating apparatus, Yarnell V-notch Waring flow meter, and heating plant. The building is of an ornamental design and the grounds are planted with shrubbery and are attractive.



Sewage pumping station

All piping, outfall, sludge pumps, pumping station and head house have been designed to meet the ultimate requirements.

The treatment works and trunk lines were designed by Nicholas S. Hill, Jr., consulting engineer of New York City.

Costs

Treatment plant	\$116,330.00
Outfall sewer and diffuser	24,487.00
Force main	26,950.00
Pumping station	34,355.00
Total cost of plant	\$ 202,122.00
Trunk lines (10.5 miles)	\$325,000.00
1st District (17.5 miles)	333,809.00
2nd District (10.75 miles)	175,000.00
Total cost of sewers, etc., to date	833,809.00
GRAND TOTAL	\$1,035,931.00

Operation

Two men are employed in the care and operation of the sewage treatment works.

A small, complete laboratory has been installed for the making of analytical determinations necessary for efficient operation. Daily orthotolidin tests are made; Imhoff cone tests; p.H. determinations of the effluent, influent and sludge; stability by methylene blue:

(Continued on page 63)

Rapid Installation of San Francisco's Emergency Water Supply

DURING the fall of 1930 it became apparent to the officials of the San Francisco water department that there would be a serious water shortage for the coming year unless the catchment from rainfall in the storage reservoirs during the season of 1930-31 was considerably above normal.

Two methods of insuring against a shortage were possible—pumping San Joaquin River water to the city's existing conduit through 22 miles of pipe to be laid over the mountains; or purchasing water from the East Bay Municipal Utility District and pumping it through 13 miles of pipe.

The latter was decided upon as most advantageous, and an agreement with the district was drawn up early in October. To carry out this plan involved construction of about 35,000 feet of 44" x 5/16" and 32,000 of 36" x 1/4" welded or lock-bar pipe, with an alternative of 46 inch and 38 inch, if riveted pipe were used. A pumping station was located at San Lorenzo with an installed capacity of twenty million gallons daily, with provisions for enlarging it to thirty million gallons a day if necessary.

The Board of Supervisors appropriated \$1,096,000 for the construction of this connection, including provision for change of the East Bay system to make possible the delivery of water at a rate of thirty million gallons daily. Immediately thereafter the city engineering department of San Francisco prepared the specifications for the pipe line; meantime the water department made surveys of the route.

Bids for the fabrication and construction of the pipe line were opened October 29, 1930. The contract, which provided for completion of the pipe line within 120 days, was awarded to the Western Pipe and Steel Company November 5, 1930, for \$648,000, on the basis of welded steel pipe dipped and wrapped with a protective coating. The pipe was laid on the surface of the ground wherever possible, depressed

under county and private roads, and elevated on blocking where the soil conditions might endanger the pipe, as a considerable length of the route was over uncultivated salt marsh land.

The right of way was obtained by condemnation proceedings December 23, 1930, and the installation of the pipe line started immediately thereafter. In spite of delays caused by rain and some right-of-way difficulties, the construction was completed on February 21, 108 days after award of contract, and in accordance with the terms of the contract the contractor earned a substantial bonus.

Meanwhile the pump station, stand pipe and appurtenances were being constructed by the water department by force account. The initial installed pumping capacity of twenty millions gallons daily is obtained by three Byron Jackson centrifugal pumps driven by three 250 H. P. General Electric synchronous motors. In order to prevent damage to the district system should there be a sudden shutdown of the pumps, an open stand pipe was constructed at San Lorenzo.

Construction of the pipe was completed February 21, 1931, and delivery of ten million gallons daily by gravity was started immediately. Four days thereafter two units of the pumping plant were completed and seventeen millions daily were delivered to San Francisco.

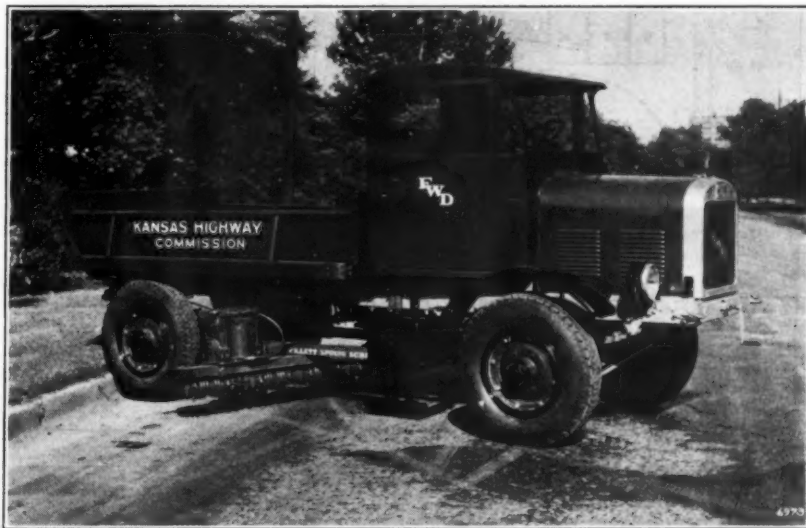
Early in March continued absence of substantial rainfall indicated the necessity of providing for more than the twenty million gallons provided for, and agreements were made to install booster pumps to bring the total capacity of pumps and pipe to approximately forty million gallons a day.

The completion of this emergency construction in such a record time is due to the splendid spirit of cooperation manifested by all parties concerned,

(Continued on page 64)

A Truck for Road Maintenance

Herewith is illustrated a maintenance truck of the Kansas Highway Commission, which one man can operate. It consists of a 2-ton truck equipped with a 2-yard body and an underbody scraper. It hauls materials, removes snow and is used for maintenance work. In some cases when the blade attachments are used, another drag or maintainer is placed behind the truck, saving an extra trip over the road and reducing the cost.



Time Losses Are Costly	
Faulty truck operation produced these time losses for a mixer on one construction job:	
Day	Minutes Lost
1	34 Minutes
2	29 "
3	61 "
4	36 "
5	87 "
6	78 "
7	112 "
8	117 "
9	138 "
10	124 "
Total.....816 "	
Valuing labor and mixer time conservatively at 70c a minute on this job, the cost of lost time in 10 days was:	
\$571.20	

Operating Motor Trucks Profitably in Contracting

Well-planned truck operation offers many opportunities to effect substantial savings on almost every contract job. These savings may help to swell the contractor's profits in either or both of two ways: (1) by preventing delays on the job, and (2) by reducing the cost of truck operation itself. The following material, taken from a report of a nation-wide survey of truck operation in contracting made by the General Motors Truck Co., is, with their permission, presented herewith in a slightly condensed form

WITH all due regard for the problems presented by different types of contracting, the fundamental questions involved in the use of truck transportation on contract jobs remains essentially the same. There are three means of saving time and money that are of direct significance to all contractors:

1. Providing better management of trucks.
2. Providing fleet capacity to fit the job.
3. Selecting the correct truck equipment.

In this article the matter of better management of trucks in regard to profitable operation will be considered.

Three Fundamental Rules of Truck Operation

TRUCKS, like any other machinery, are simply tools which the contractor uses in his work. To get the most from these tools, they must be handled properly. Profitable truck operation is based on three important rules:

- Rule 1: Keep each truck in active use the maximum part of each working hour throughout the day.
- Rule 2: Give each truck its specified load on each haul.
- Rule 3: Make sure that each truck travels at the maximum established speed that is safe for the load and the haul.

Naturally, these rules are ideals which cannot always be fully attained in actual practice on contract jobs. But unless there is consistent effort to apply these three fundamental principles, excessive losses are certain to occur. The instance shown in Fig. 1 is typical. On this job, before a competent engineer straightened out the tangle, all three of the basic rules were being violated. The result, in ten days, was the loss of mixer time worth more than \$570, to say nothing of other losses less easily traced.

Since timely movement of materials is the first requirement of truck operation on a contract job, the first rule for sound truck operation—*keep each truck working a maximum part of every hour in the day*—is doubly important. Delays and lost time may mean that materials will be slow in reaching the job. And those same delays, by lowering the productiveness of the truck, will increase the cost of moving materials. Only when the contractor has eliminated every possible cause of delays, can he be sure that his movement of materials will be both timely and economical. During this investigation, outstanding delays in truck operation were observed at four points:

- 1 Loading
- 2 Driving
- 3 Unloading
- 4 Maintenance

The practical methods that save money on these four points will be discussed in this section.

Time Savings at the Loading Point

Time saving and profit making begin right where the truck is loaded. When a contractor relies on supply houses or sub-contractors to bring materials to the job, the methods they use in loading their trucks may, of course, be something beyond his control—although it is often likely that their delays in load-

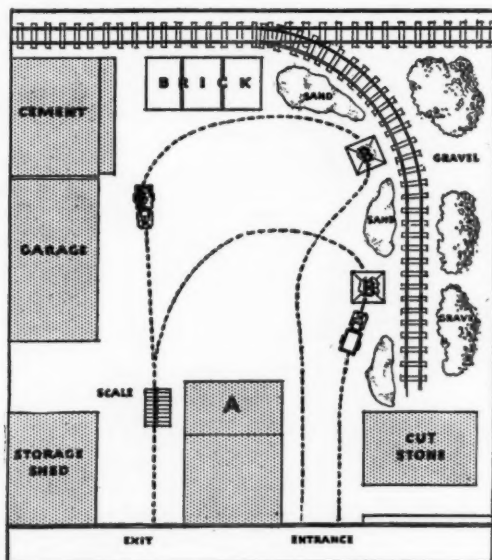


Fig.2—An efficient yard layout.

ing may hold up his own men on the job itself or lead to waits that will interfere with his schedule. But when he operates his own trucks, efficiency in loading should receive his careful attention.

For example, one busy general contractor, who operated 18 trucks on full time from his own supply yard, had installed a makeshift hopper built by his own workmen. On the average, it took 1 minute longer to load and trim than would have been required with a properly designed hopper. And when the hopper was almost empty, the last yard of material had to be shoveled through the vent.

On the average, each truck made 11 trips a day. So here was a loss of 11 minutes per truck, or a total of 198 minutes for the fleet, each day. In other words, more than three hours a day was wasted. Figuring truck time as worth \$2.50 an hour, the waste was \$7.50 a day or \$187 a month. At that rate, two hoppers of proper design would pay for themselves in a relatively short time.

Similar opportunities to save time and money present themselves again and again. On one excavating job observed during the survey, for example, an average of 1 minute, 38 seconds was lost in bringing each dump truck into loading position. With 12 trucks on the job, each making 8 trips a day, the total time wasted in a day amounted to 2 hours, 36 minutes—unproductive time for the trucks and idle time for the shovel.

In this case, to be sure, it would have been impossible to eliminate all of the loss of time, for difficulties involved in routing the trucks past the loading point made some wastage inevitable. But when a few simple changes were made, permitting the trucks to pass the shovel with less maneuvering, the waste time was cut to less than 30 seconds a load.

Yard Layout Can Save Time.—While a contractor operating his own supply yard cannot well afford to make costly changes in its layout in order to effect small improvements in loading, simplicity in ar-

Fig. 3—Ticket for handling orders on time-clock system, recording time order is received, time given to driver, time delivered by driver, and time received copy is returned to the office.

OFFICE COPY			
SMITH & SONS No. A-02869			
MASON CONTRACTORS			
18 Willow Road			
Phone Bayview 132			
Deliver to..... <i>1830 Long Drive</i>			
Quantity	Material	Price	Total
<i>7.025</i> <i>44.</i>	Crushed Stone		
	Gravel		
	<input checked="" type="checkbox"/> Sand	<i>1.50</i>	<i>5.25</i>
	Bags Cement		
Received By <i>H. H. Banks</i>		Time <i>11:03</i>	Order Received <i>10:20</i>
Delivered by <i>Curtis - 63</i>		Truck Out <i>10:25</i>	
Driver		Truck In <i>11:25</i>	
Please note any delays of more than 15 minutes on reverse side of this ticket.			

rangement always deserves careful study. Often some easily made change, such as widening the entrance to permit free passage of trucks or placing the order room more advantageously, will materially speed up the loading.

For example, in the layout of a mason contractor's supply yard, shown in Fig. 2, note the following points:

- A. The office has a commanding view of the entire yard.
- B. The hoppers are located so that the trucks can circle the yard in one turn.
- C. The cement platform accommodates two trucks at a time.

(Continued on page 82)

Heavy Materials for Buildings and Roads

Sand and Gravel

The pit at the mixer should be of sufficient capacity to take the entire truck load. A 5-yard load for a 3-yard pit means fully 5 minutes extra dumping time.

There should be sufficient space for dump trucks to back up to the mixer with a single turn of the wheel. Narrow turning space requires jockeying around, at a considerable loss of time.

The area around the mixer should be kept free from other traffic. Time and again, during the survey, office cars and other supply trucks were observed interfering with the operation of the dump truck engaged in making delivery of material to the mixer.

Cement

When cement is delivered in bags, sufficient labor should be available immediately for unloading. It takes one man 55 minutes to unload a 200-bag delivery. Three men can do it in 20 minutes, saving 35 minutes of truck time.

When trucks are used in hauling batch loads to a mixer, a considerable amount of time is often lost in adding cement to the batch—in untying bags and in dumping. The volumetric measure with gravity dump aids considerably in saving time on this type of construction.

Steel

Quick spotting of trucks and prompt unloading at the proper place, so that the steel will not need unnecessary movement later on, are essential. In crowded business districts especially, where storage space and unloading space are at a premium, a fixed method of identifying steel helps to save time for the trucks and for the construction.

Brick

In some cases, trailer operation is highly advantageous in transporting face brick, as it permits the truck or tractor to spot the trailer and return for another load while the first one is being unloaded. Trailer operation, however, requires careful consideration, as is pointed out in a later portion of this Report.

FIG. 4

DRIVER'S DAILY REPORT

Name..... Truck No.....
Reported for duty.....

Gas put in.....
Oil put in.....

Anything wrong observed in motor, chassis, body or hoist.
State trouble:

If anything wrong was reported yesterday, don't take truck out of shop without foreman's written okay on back of this card.

Any delays on route or at delivery because of receiver's handling? If so, state briefly:

Mileage out.....
Mileage in.....

FIG. 5

Principles of Design of Steel Highway Bridges*

By Earl Feldman

St. Joseph Co. Surv., South Bend, Indiana.

RECENT changes in construction methods have favored some types of bridge construction over others. For example, many channels which were formerly constructed by large floating or walking dredges are being excavated today by light machines mounted on crawler treads using draglines, the bucket of which can easily be placed underneath a bridge and clean a channel which could not be cleaned by the older type of dredge without removing the superstructure.

Foundations

In some cases contractors have been subjected to monetary loss by improper construction of the cofferdam. In locating the struts in the bracing system of a cofferdam, care should be taken to so place them as to permit driving of any foundation piling in the position designated on the plans.

If the excavation is in material that does not permit the easy passage of ground water, it may be permissible to allow the footing concrete to be deposited next to the sheeting. But if water enters the foundation pit, it is well to construct the cofferdam so as to permit the water to pass around the neat lines of a footing to a sump, from which the water can be removed continuously by a pump while the concrete is being placed.

In designing piling for a foundation, we should not group the piles so closely as to interfere with the individual supporting action of each pile, which requires a minimum spacing of about three feet on centers; this, however, not applying to conditions where the piles act as columns by being driven to a bearing on rock or other hard stratum. If it is desirable to seal the bottom of the excavation for the foundation concrete by means of a layer of concrete, such seal should be stopped several inches below the top of the piles in order to permit the remainder of the footing to bond onto the projecting butts.

In Indiana the types of foundation with which we are chiefly concerned are steel cylinders, frame or trestle abutments, wing abutments, U abutments and counterforted abutments, sometimes using concrete pile trestle bents with a concrete cap. Selection of a type of foundation should be controlled by considerations of cost, type of fill, high-water elevation and other factors.

The use of steel cylinders is not as common today as it was twenty or thirty years ago. Frame or trestle abutments constructed of concrete should be more widely used than they are, as this is an economical construction and lends itself to rapid completion and is quite satisfactory when the cost of increasing the length of the bridge is less than the cost of retaining the fill of the approaches.

The wing type of abutment is generally of the semi-reinforced cantilever design, obtaining its stability by its own weight and by the weight of the fill. The maximum soil pressure is at the edge of the footing

next to the stream, and if the footing is piled, the grouping of the piling will be closer at this location. This type of construction is seldom economical for a height exceeding 25 feet. The form work cost per cubic yard of concrete in place is less for this type of concrete abutment than for any other design in concrete.

U abutments are usually economical for heights exceeding 25 feet. One of the advantages of this type is that the roadway fill which is being retained assists in reducing the overturning moment on the abutment proper by lending its weight and friction to holding the wings of the U, which are constructed monolithic with the abutment proper. Step footings may be used to reduce the excavation. The wing walls are tied together by concrete beams which pass horizontally through the fill. Obviously, this type of construction which employs tie beams cannot be used economically for roadway widths exceeding 25 feet.

Counterforted abutments are usually economical in heights above 20 feet. This type of construction contains less concrete than the semi-gravity type and utilizes the roadway fill to assist its stability against the overturning forces.

In general it may be said that, as the quantity of concrete in an abutment for a given site is reduced, the cost of the form work is increased; also, since the thin sections are highly reinforced, it is not easy to place concrete in them.

In designing concrete structures, remember that every time the direction of a plane surface is changed, the cost of the form work is increased. The more heavily a section is reinforced, the greater the cost of placing the steel. Intricate form work reduces the salvage value of the dressed lumber. Inspection of heavily reinforced concrete work requires a more experienced class of inspectors than semi-reinforced work. Abutment construction of highly reinforced nature should have all construction joints correctly placed and the reinforcing steel should be of such length as to develop its tensile strength by bond or by hooks. Abutments should be designed to withstand all the forces acting upon them and should be stable without the load of a superstructure. Construction joints which are located so as to receive shearing stresses must be provided with keyways of sufficient size and shape to transfer the shearings and bearing stresses.

Designing the Superstructure

The number and shape of the spans of a bridge are important from an artistic viewpoint. As far as possible, an odd number of spans is preferable to an even number. Although at times it may be economical to mix types in the same bridge, this may not present the best appearance to the eye and may bring criticism upon the engineer. Among the factors which should affect the selection of a superstructure are the nature of the traffic with respect to loads and frequency, the differential between the elevations of roadway and

(Continued on page 89)

* Abstract of a paper presented at the Seventeenth Annual Purdue Road School.

The Tractor in Road Maintenance Work

By W. H. Root

Maintenance Engineer, Iowa State Highway Commission



The Iowa primary road system on January 1st, 1931, totalled 6,820 miles, of which 860 miles were earth roads, 2,700 miles were untreated gravel, and 3,260 were paved. From experience in maintaining these large mile-ages of different classes of roads, Mr. Root would seem to be well qualified to write on this subject.

IT CAN be said truthfully that the tractor is indispensable in economical road maintenance. The tractor has its place in the maintenance of all types of roads, from the unimproved dirt roads, through intermediate gravel and stone types, to the highest type of paved roads. But it is my opinion that a state or county can get more value in return for each dollar spent in tractor blade grader work for unimproved dirt road maintenance, than from any other class of equipment. Tractor-powered maintainers are used in the construction as well as in the maintenance of the unimproved dirt roads.

We in Iowa can transform roads which are mere trails to roads which are comfortably wide, well-drained, and admirably suitable for farm-to-market traffic, at an expenditure of from \$200 to \$300 per mile. These roads provide good traffic surfaces for all periods of the year, except during the spring break-up, and for a few hours following summer rains. As a matter of fact, in a large portion of the state we consider these earth road grades satisfactory for secondary road construction when they are given further improvement by surfacing with gravel.

After improving these low-type secondary roads, we find the tractor an economical machine for surface maintenance. The tractor may be used to pull a blade or other maintainer, or the push-type of grader may be built around it. Such an outfit will not only do better work than can be done by teams, but it will maintain the surface at less cost than any other method. This is due to the fact that the tractor-powered grader maintains a wider strip and travels at a faster speed than horses. I doubt if there are any roads which can be considered in the farm-to-market system that can be maintained as efficiently or with the cost as low as where the work is done with tractor-powered units.

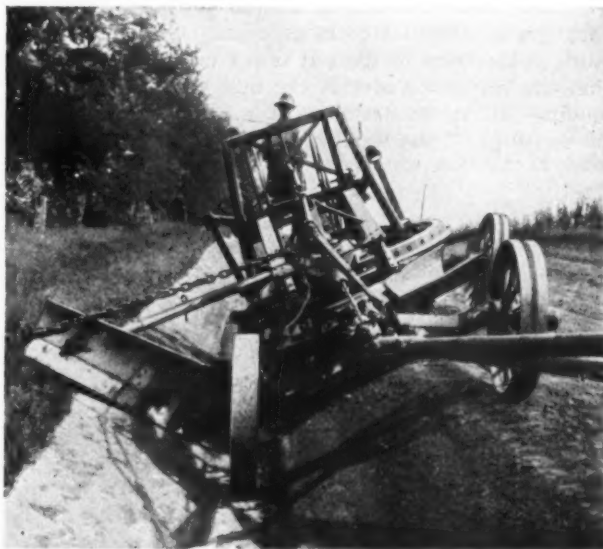
Maintaining Gravel Roads

Untreated gravel and stone roads also can be maintained more efficiently and at less cost with tractor-operated equipment than by any other method. On such roads we use both types of maintainers—the individual pulled ones and the built-in outfits. There is a tendency in some states to use high-powered

trucks for pulling maintainers on gravel maintenance. This may be economical if the trucks are required in the state's snow-removal program; in other words, if the truck maintenance is incidental to the job of removing snow. However, I question that even in states where such maintenance is most prevalent, would they contend that maintenance with trucks is cheaper than with tractors, if snow removal is disregarded and the surface maintenance work is required to absorb all depreciation costs.

The untreated as well as the treated gravel and stone roads require periodic scarifying to meet traffic conditions. The tractor is admirably adapted for scarifying work, due to its weight and the high draw-bar horsepower available. The same motor graders can be used on all types of roads; they have ample weight, which is adaptable to the work required to maintain properly the various road surfaces.

We find that in the flat country gravel roads settle out of shape and, due to the surface wash, the ditches



Cleaning out and reshaping ditches and shoulders north of Des Moines.

Cut at top of page shows grader used in gravel surface work north of Ames.

fill so that it is necessary to reshape them entirely every four or five years. Our plan of procedure is first to cut the gravel from the shoulder with a tractor-powered grader. This gravel is deposited in a windrow about 10 feet in from the shoulder line. Then, with a tractor-pulled 12-ft. blade and back-sloper attachment, we clean the ditch and reshape it to its original contour.

The material taken from the ditch is used to build up the low shoulder. After this work has been completed, the windrow of gravel is spread over the surface of the new shoulder with the tractor-powered maintainer. This reshaping work usually mixes so much dirt with the surface gravel that it is necessary to add a new coat of gravel. We find that 500 cubic yards per mile is generally sufficient for this work. The new gravel is distributed uniformly over the surface with the tractor grader.

On first thought, it might be assumed that tractor maintenance ceases when the road is paved. It is true that the maintenance work on pavement is somewhat limited as compared with other types of roads, but we find the tractor and maintainer are indispensable even here. Again, it is necessary to open ditches and reshape shoulders—the same as on the gravel roads. We have a number of tractor mowers which are used in cutting weeds and grass on the pavement shoulders. It is our policy to keep such vegetation cut close to the ground by frequent mowings.

Snow Removal

In snow-removal work, tractors are used in two general ways. Tractors equipped with push plows break through the heavy drifts. These outfits are capable of opening up the most severe blockades in this part of the country. The other class of snow-removal work which can be taken care of generally with the regular maintenance outfits is removing light coatings of snow and ice from paved streets. On heavily traveled roads, wet snows, even though light, are often packed into ice before the maintenance crews can cover the entire mileage of roads in their respective sections. This packed snow soon becomes a serious menace to travel, as well as to the road surface itself. The latter is especially true if ruts are worn in the snow or ice. It is our experience in Iowa that the tractor grader is the best equipment for removing this accumulation as soon as it softens slightly by melting. Thus we find the tractor-powered main-

tainers become a year-round factor in our road maintenance program.

I have outlined only a few of the outstanding uses of tractor power in road maintenance. However, every maintenance engineer knows of many other uses for tractors. I might sum up the tractor's value in maintenance work by saying that tractors are as important in maintaining roads as is apple pie in the famous apple-pie-cheese combination.

The above article appeared in "Powertrax," published by the International Harvester Company, 192 of whose McCormick-Deering tractors are used in Iowa State highway service, three of which are shown in the illustrations.

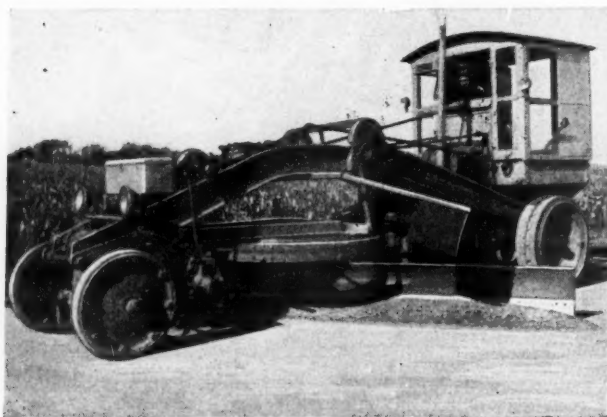
Cambridge, Mass., Installs More Efficient Pump

The pumping engine at the Fresh Pond pumping station of the municipal water supply of Cambridge, Mass., having been almost worn out after long and continuous service, the water board last year asked for bids on a new 20 million gallon pump, acting on the advice of A. O. Doan of Boston as consulting engineer. The bid accepted was that of the Worthington Pump and Machinery Corp., for a horizontal cross-compound crank-and-flywheel condensing engine with a guaranteed duty of 144 million foot-pounds of work per thousand pounds of dry steam.

The engine is of the standard Worthington opposed type, with double acting steam cylinders at one end and double acting pump cylinders at the opposite end of the engine frame. The steam cylinders, consisting of a 26-in. high-pressure and a 60-in. low-pressure unit with 42-in. stroke, are equipped with Corliss valves throughout. The pump plungers, which are of 26½-in. diameter, are of the outside center packed design. Inlet and exhaust valves of both high pressure and low pressure steam cylinders are driven by separate eccentric and wrist plates. This arrangement permits of the most accurate timing of the valves which is a contributing factor to the high economy obtained with this unit. Because of its size and length of stroke, the low pressure cylinder is equipped with a tail rod; that is, the piston rod extends through both ends of the cylinder, each end of the piston rod being supported by a crosshead. With this arrangement the weight of the piston is carried almost entirely by the piston rod, thus relieving the cylinder of considerable pressure and consequent wear.

Auxiliary equipment comprises a large surface condenser of the conventional water works type, and independent air pump for removing the condensate from the condenser, a large feedwater heater located in the exhaust line, an auxiliary feedwater heater, attached boiler feed pumps driven from the main cross-head and, for condensate removal, a steam separator located adjacent to the high-pressure cylinder throttle valve.

The official duty test was run for nine hours on Sept. 10th, 1930, and a duty of 148.6 million foot-pounds was developed, 4.6 million more than the guarantee. The contract had called for a deduction of \$900 from the payment for each million foot-pounds by which the engine should fall short of the guaranteed duty.



Push-type maintainer working in Pocahontas county

“Where’s the Sewage Works?”

By Morris M. Cohn

Sanitary Engineer, Dept. of Public Works, Schenectady, N. Y.

WE swung off the hot, dusty train as it screeched to a stop at Xtown and the engine puffed like a gassing Imhoff tank from its pull in the humid, drowsy autumn afternoon. Fresh from a profitable technical association meeting, we were filled with the latest information on sewage treatment as it is practiced today. The day before, there had been a paper read by the Xtown plant operator, a good paper, with good ideas about all those problems that were bothering us. Fine fellow that operator, fine plant he must have. To pass through without inspecting the works would never do.

A station cab-driver swung open his door with alacrity, we bundled in, the starter stirred the engine into life. “Where to?” with a smile that fairly shouted, “I know every inch of this town.” “To the sewage disposal plant.”

The brakes groaned, the driver’s hat came off and thoughtful fingers scratched a puzzled head. The fellow who knew every inch of town didn’t know where the sewage-works could be found. At the City Hall we left our guide with, still, a doubting expression on his face.

The City Clerk asked his deputy, and that official vouched the information that the City Engineer would know how to reach the works. The City Engineer, by all means. Our names brought no signs of recognition to the face of our professional colleague but he could give us the much desired directions and, better yet, get us there. This was more like it. As we waited for a conveyance we tried subtle flattery. “You have a nice plant here and your operator is doing a good job of operating it.” The seeds fell upon unsludged soil.

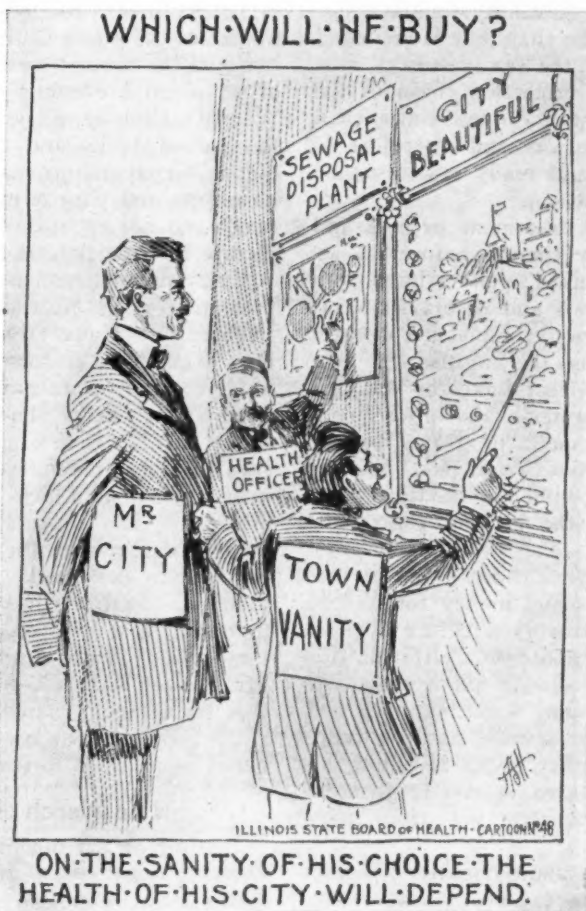
Out along many streets, a bit over country road and then the familiar glint of concrete and the gleam of iron-work welcomed us into a world that breathed the same atmosphere as the technical session of yesterday. What matter that we had to rout the paper-reading operator out of a pump manhole? Our names meant something, questions about pH and methane brought quick response, a spirit of unanimity per-

meated the plant until we got aboard the wheezy official car of the operator and clattered back to make a train in the cool of a peaceful evening.

Xtown is your town and mine, too. Cab-drivers have, no doubt, wandered all around your town, too, looking for the elusive sewage-works and wound up by depositing their fares at the portals of a garbage plant. You, perhaps, have also answered the ‘phone and heard the voices of some personage in sewage treatment wailing from the uptown wilderness and asking, please, for specific directions to the plant. Likely, you too have button-holed a visitor who also knew sewage and its vicissitudes and talked into the wee hours of the morning, pouring out your soul.

The average citizen, even the official superiors of the plant superintendent, are not to blame for this

deplorable exile of the treatment works and its operating staff. The responsibility lies at the threshold of the operator who is, figuratively, spending too much time down in the pump manhole. Why should people be interested in what becomes of the liquid wastes of life after they have wished it a cordial adieu in the kitchen, laundry and bathroom. Their conceptions of sewage and sewage-works are of things no one would care to see. There is an amazing misunderstanding of the entire matter. To most folks, sewage and garbage are one substance and containers and sewers are confused to a ludicrous degree. The common wonder is how sewage can flow through sewers, and plant workers are conceived as working knee-deep in muck, “pushing it” all day, “it” being a vile, unnamed, amorphous material. The plant is, by the average idea, a series of vats filled



with oozy debris, giving off odors that are nauseating and supplying a feasting place for half the flies under the sun. Is it any wonder that the cab-driver looked askance at two human-looking men who asked to be transported to the municipal out-house?

The misunderstanding of things sewage comes back to roost with the officials who have failed to “sell” the idea to the public. A few months ago,

the taxpayers of a certain northern New York village voted down a proposition to bond the village for \$200,000 for the purpose of constructing a sewerage system and a sewage treatment plant. The rejection of a project so intimately connected with the health and comfort of the town indicates a woeful misconception of their duties to themselves and their neighboring communities. It was at such action that a cartoon, issued by the Illinois State Board of Health some time ago, was aimed. It depicted a citizen standing in indecision before the plans of a City Beautiful and a Sewage Disposal Plant. The former project is being urged on him by "Town Vanity," while the construction of the latter is being supported by "Health Officer." Under the cartoon, the caption reads, "On The Sanity of His Choice The Health Of His Community Will Depend." The "nay" vote of New York is the problem. The cartoon of Illinois is the solution.

An expensive car rolls down the plant road, stops and a dignified gentlewoman peers admiringly through a raised lorgnette at the play of the filter nozzles. A question about what becomes of the water brings the reply that it is sewage, not water, and that this is a sewage-works. A dainty handkerchief rises to a haughty nose and the chauffeur is motioned on. Isn't it high time to sell the sewage-works as a necessary link in the health protection chain of the community? It can be done. A newly-awakened tax-payer is interested in the why and wherefore of his tax dollar. He will be found ready to investigate any phase of city government.

Automatically, the sewage treatment process and the sewerage system is today coming before the attention of the public. Milwaukee opens a huge activated sludge plant and models and displays appear in down-town windows. Chicago completes a monster works and local papers discuss the engineering feat. Water is removed from the Great Lakes by the Chicago drainage canal and protests and government permits and stipulated treatment programs become syndicated news stories. New York lets contracts for the largest plant of its kind in the world and metropolitan papers discuss the bids of contractors for the general construction. The Ohio sewer rental law swings into effect and Mr. Citizen discovers that the sewage he produces costs him money for its trip through the sewers and its treatment before disposal in the river. The towns of Southern California discuss the possibility of using sewage plant effluent to augment the inadequate ground water supplies. A people becomes interested in sewage and its treatment when there is a possibility of its becoming his drinking water. Sewer failures in two large cities result in political shake-ups that get front page prominence.

The time is ripe for the plant operator to enter the lists and do battle for the cause of sewage treatment. It can be done in various ways. Hospitality to basket-picnickers in the cool, shaded spots of the plant site suffices for one work. Construction of a free golf course suits another city's needs. An official luncheon-reception at the plant marks the opening of another work. Distribution of a few bags of sludge to householders, at no charge, is bringing many citizens to another plant and resulting in good will and greater understanding. Invitations to science

classes in local schools and merit badge candidates of Boy Scout troops will bring many youngsters to sewage-works and spread favorable information in many homes. The publication of plant weather data in a local paper under the daily heading "local temperatures as recorded at the sewage treatment works" brings city-wide realization of the technical activity at still another installation. The people can be made to realize that the sewage-works does exist and that it is interesting and instructive.

It has been my pleasure to make a motion picture of our sewage treatment process within the past few months. In its preparation, the local college and the municipal research bureau cooperated. It is a human picture, opening with scenes showing sewage production in the home and tracing the sewage through pumping station and the interesting treatment devices. It is replete with pleasing views and is interspersed with light, cheerful titles. It beseeches at the final fade-out, "Won't you come down? You'll find the works clean, inviting and prettier than the picture." I have been privileged to address and present our picture at noon luncheon meetings of singing Rotarians and cheering Kiwanians. I have sat at dinner with the professional and business women of the Zonta Club and offered a talk on sanitation and the sewage treatment film as a fitting climax of a splendid evening. The portals of the stately Women's Club have opened for me. The pictures of the Imhoff tanks and trickling filters have flashed before taxpayers' groups, community betterment associations and church men's clubs. High school students and nurses' training school girls have seen the picture as a portion of their social science courses.

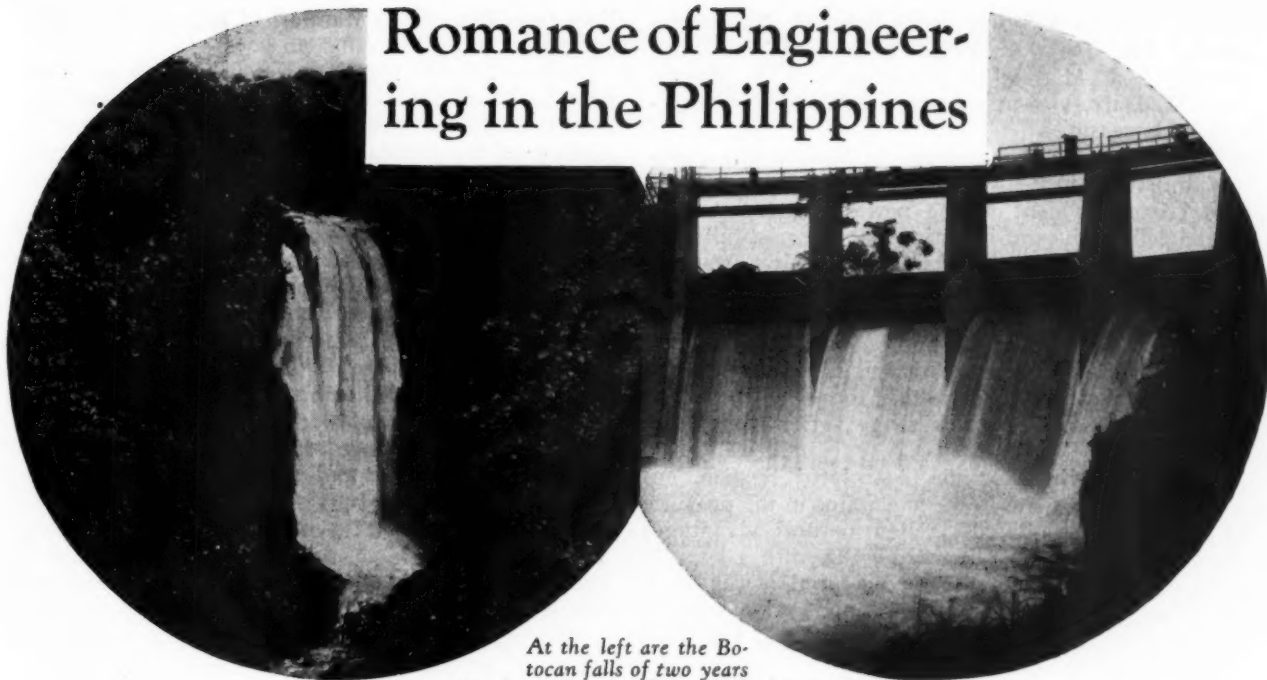
Everywhere there has been awakened a keener appreciation of the necessity for sewage treatment in a community. Many misconceptions have been cleared up. Numerous visitors have appeared at the plant, to view in person the units portrayed in the film. Open forums after many showings of the picture have resulted in discussion of the principles of sanitary science involved. Men, women and children alike have raised questions which have required careful, direct answers. The process becomes entrancing to the general public when the biochemical agencies of purification are explained. Distaste has been changed to surprise. Surprise has given way before conviction that here is a necessary health measure. When the time comes to raise funds for sewage plant expansion, Mr. Citizen will not, I trust, stand in indecision before the alluring plans of a city beautiful.

"Where's the sewage-works?" It was in exile but it has been "sold" to the public and it is coming back.

The March of Sewerage in Ohio

During March the State Department of Health of Ohio approved of a number of plans for sewerage which were submitted to it, including a branch of Big Creek interceptor in Cleveland; sewage treatment plants for schools in Mahoning county, Osborn county, Summit county (two), and Van Wert county. Also a sewage treatment plant for Medina. Also it approved contracts for three sewers in Cleveland—two connections to the Walworth Run diversion sewer, and the construction of the Big Creek interceptor. It also approved of the development of a new water supply for Greenwich.

Romance of Engineering in the Philippines



At the left are the Botocan falls of two years ago. At the right, the dam which diverts the stream into the tunnel on its way to the power house.

OVER the mountains and through the jungles, over swamps and through coconut groves, 16,000 kilowatts of electricity now flash their way from the mountain gorges of the province of Laguna to light the city of Manila, 55 miles away.

The story of harnessing the Botocan river is not only significant as the first large-scale hydro-electric development in the power history of the Philippines, but is also the most dramatic story in modern engineering on the islands.

For sixteen months, 2,500 men, working three shifts a day, have been waging constant warfare against every kind of natural obstacle in order to put this hydro-electric project on the Botocan river into operation. Their task is now completed.

The beginning of the Botocan Falls development goes back to 1901, when William Howard Taft was appointed by President McKinley as civil governor of the Philippines. Governor Taft soon realized the power possibilities of the islands' mountain streams. He visited Botocan and, to get there, was carried over miles of miry roads by perspiring Filipinos. Later he advertised that the Philippine government would be willing to grant a concession for the purpose of building an electric light and railroad system on the island.

Charles M. Swift, a Detroit lawyer and railroad builder, heard about this advertisement and through a mutual friend arranged with J. G. White, one of the

best known engineers in the world at that time, to make a bid.

On March 24, 1903, the Municipal Board of the City of Manila granted Mr. Swift a franchise to operate an electric railroad and to furnish electric current

for light, heat, and power in the city and suburbs. Mr. Swift raised necessary capital in the United States, London, and Amsterdam, and formed the Manila Electric Railroad and Lighting Company. The new company entered into a contract with J. G. White and Company of New York to construct the system and after construction to act as operating manager.

On April 11, 1904, Mr. Swift acquired the assets and franchises of the Campania De Los Transvias, an old Spanish horse tramway company; and in August 1904 bought La Electricista, a Spanish

company operating an electric light and power plant in Manila. In 1906, Mr. Swift organized the Manila Suburban Railways Company.

The Manila Electric Company was incorporated May 1919, leasing the property of the Manila Electric Railroad and Lighting Company, the Manila Suburban Company, and La Electricista. In the latter part of 1921, the properties of the three companies were sold to the Manila Electric Company and the lessor companies dissolved.

In April 1925, the Manila properties were acquired

In a Philippine jungle, sixteen miles by trail and primitive road from the nearest railroad, where monkeys, wild boars and rock pythons abounded, where it rained three days out of four and floods and typhoons were frequent, United States engineers have built a dam more than one hundred feet high to utilize the power from a falls with a straight drop of 215 feet. Many coffer-dams were washed away during the construction, one the night after it was built. All this sounds like romance, although we doubt if it seemed so to the engineers at the time. A sketch of what they did is given in the following article, for which we are indebted to "The Associated Magazine," published by the Associated Gas and Electric System.

by the Associated System, with John H. Pardee replacing Mr. Swift as president, and the following officers: J. I. Mange, H. C. Hopson, S. J. Magee, John M. Daly, vice-presidents; T. W. Moffat, secretary and treasurer.

The business of the company in Manila was growing at a steady rate. The need for added power facilities became evident to the new management, and Associated engineers, investigating the possibility of hydro-electric developments, had their attention drawn to Botocan Falls.

Manila, located on the Island of Luzon, is the power market of the Philippines, but is so situated that no hydro-electric development is possible nearer than the mountain range which forms the backbone of Luzon. Distance to this range varies from 30 to 50 miles.

After surveying for the Associated System, engineers selected a site in the mountains in the province of Laguna which offered excellent natural advantages for power generation. Botocan Falls, with a straight drop of 215 feet, was a good potential power head, while an ideal site for a generating station was the point below the falls where the Botocan and Dalituan rivers joined to form the Banalac.

The country is picturesque, old Mount Banahao forming a background of decadent majesty, while the Botocan and other rivers dash down cliffs and slip through deep gorges. Tropical vegetation covers the slopes. Monkeys and parrots abound, and in the more rugged regions wild boars and rock pythons make their lairs in unexplored caverns.

These mountain streams are fed by perennial rains, excellent for hydro-electric purposes but a serious impediment to heavy construction. At Botocan, in 1929, the rainfall was 24 feet, and over the entire Botocan watershed it averages between 14 and 24 feet a year. A tremendous amount, when one compares it with the less than four feet of annual precipitation in New York City. Sometimes the dry season fails to materialize at all, but theoretically the rains are heaviest in July, August, and September, and lightest in February and March. During a period when some of the most important work was being done on the Botocan project it rained 32 out of 45 days.

These rains are often accompanied by terrific typhoons. Steel towers that carry the transmission

lines from Botocan to Manila had to be built to withstand a wind of 150 miles an hour.

In September of 1928, Charles B. Hawley and Company of Washington was engaged by the Associated System to do the investigating, engineering, and designing of the Botocan Falls station. This company was represented on the job by James K. Richardson and F. D. Matthews.

On August 15, 1929, George E. Schreiber arrived in Manila. Mr. Schreiber had charge of the construction for W. S. Barstow and Company, construction unit of the Associated System. He remained at Botocan until May 1, 1930, when the work was taken over and completed by his assistant, Ernest D. Bean. Mr. Schreiber established his headquarters at Botocan.

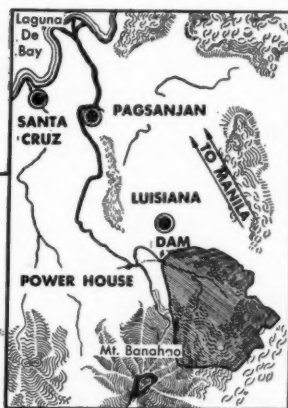
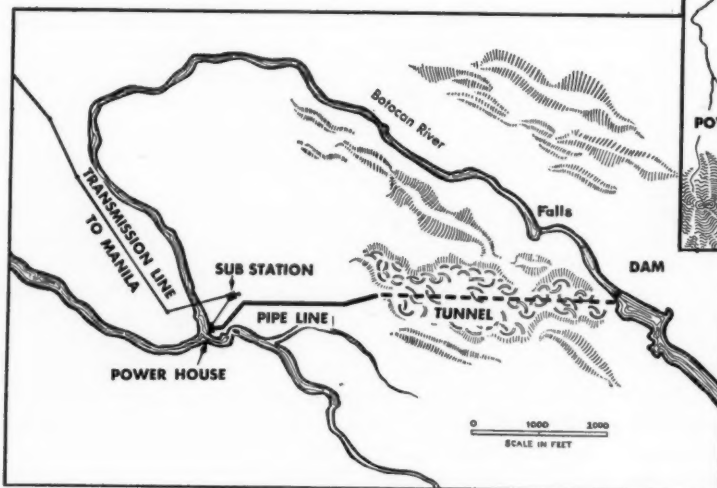
The falls are 55 miles from Manila by airline. By road and water they are 95 miles. The nearest point to the falls at which supplies could be loaded was the wharf and railroad at Pagsanjan, 16 miles from the site itself. Eleven miles of this was a primitive road from Pagsanjan to the town of Luisiana, while the last five was merely a miry trail up the mountain used by coconut cutters.

The old road from Pagsanjan had to be put into condition to bear heavy trucks transporting stone for cement, supplies and heavy machinery. The trail from Luisiana had to be built into a road to the site of the dam and beyond that to the top of the gorge above the power house location. For ten weeks every bit of lumber, every cupful of water, and every can of food used in the construction camp at Botocan had to be carried by hand up the mountainside from Luisiana. Meanwhile, construction gangs, handicapped by continual rains that turned every fill into a sea of waist-deep mud and every mountain brook into a torrent, began building a real road 10-feet wide.

Nearly all the workers were detailed to this job. In the meanwhile, the 11 miles of road from Pagsanjan to Luisiana began to go to pieces, because it was not thick enough to stand heavy traffic in the rainy season. So Associated engineers had to furnish stone and men to keep it in repair.

Reconstruction of the road from Pagsanjan to Luisiana presented equal difficulties. Seven bridges had to be rebuilt along the way. It was finally found necessary to install booths with telephones and gates one mile apart over the 11 miles of road in order to establish one-way traffic. This reduced the expense of keeping the road in condition and also helped to reduce accidents. By March 15, 1930, the roads were reported in excellent condition. Ninety trucks operating over this road delivered about 500 tons

(Cont. on page 67)



Above, general map of country along Botocan and Banalac rivers. At left, map on larger scale, showing location of dam, tunnel and power house.

THE EDITOR'S PAGE

What Kind of Stand-by Equipment?

WHEN pumping is necessary in connection with either providing water or removing sewage, it is *very* necessary, and intermission in pumping for any length of time is disastrous.

To provide against such disaster, stand-by pumps must be provided; and, as the intermission may be due either to the source of power or to the machinery itself, a stand-by using a source different from that which operates the other pump is desirable.

As the stand-by pump is to be used only occasionally and for short periods, efficiency is of less importance than first cost. But efficiency and reliability must not be confused. When the stand-by pump is called into service, God knows the operator has enough trouble on his hands without having *that* break down too.

And the demand on its reliability may be great. After standing idle with thickening lubricants for months, it is suddenly called upon to render the full service into which the regular equipment was brought gradually, and the material throughout should be of the best. Since the stand-by is used seldom, there is less opportunity to test it out for weak points and more reliance must be placed on the reputation of the maker than in purchasing the regular operating equipment.

Engines which have to be speeded up beyond the characteristics of their design have been offered—and accepted—recently on the basis of price only, in competition with properly built equipment put out by responsible and widely known firms. The recent industrial depression has increased the temptation to do this, but can not justify it. Municipal engineers and officials should not hastily purchase the products of firms who do not advertise and are relatively unknown but sell their goods on a price basis alone. With few if any exceptions, firms which have been selling reliable goods for a number of years, advertise them. It is *possible* that good equipment can occasionally be had from non-advertisers; but it is *certain* that only properly built equipment, produced by responsible firms, can be advertised successfully over a considerable period of time.

Municipalities Combine in Buying Commodities

Last year the director of the Michigan Municipal League, Harold D. Smith, offered the services of his office in purchasing staple commodities for the member cities of that organization. Six city manager municipalities tried out the idea by pooling their requirements for fire hose, which totaled 5,200 feet, and bids were received for hose bearing underwriters laboratories' label from ten manufacturers—five of them identical in price. The price accepted for hose, to be delivered in separate consignments to the six cities, was 64 cents a foot; while other Michigan cities at that time were paying for hose of similar quality and size an average of \$1.30 a foot. In November twelve municipalities combined in a joint order for 7,300 feet of hose, which also was bid at 64 cents.

Encouraged by success in this line, the Michigan Municipal League decided to try joint purchases of chemicals and other staple commodities.

Of course, a saving of 50 per cent can not be expected in many lines of goods, but 10 to 20 per cent seems possible, and is certainly worth while. There are several difficulties in the way of such cooperation between cities, among them the necessity that all agree on identical specifications, and the absence of an agency for bringing about an agreement between a number of cities and for making the purchases. The former should be eliminated easily for most staple commodities, for standard specifications for practically all such have been adopted by the American Society of Municipal Engineers, the American Society for Testing Materials, and other organizations of recognized standing. As for the agency, many states have state organizations composed of municipalities as members—Cities of the Third Class of Pennsylvania, Conference of Mayors of New York State, and leagues of municipalities of many of the states.

Most large cities have purchasing departments by which savings are made by pooling the purchases of all departments and also by having experienced purchasers who watch the market and learn when and where to purchase to the best advantage. The state league could maintain one or more experienced purchasers to perform the same service; but even the mere securing of joint action through the league's secretary in the purchasing of staple items of general use by cities would undoubtedly result in a worthwhile saving, and give to the small city the advantages now confined chiefly to the large ones.

Large-scale purchasing, jointly for a number of units, is one of the advantages of chain stores; it is practiced by the Committee on Standards and Purchases for the Y. M. C. A.'s throughout the country; and is a logical development of recent tendencies which seems to offer advantages that small municipalities might well avail themselves of.

Seventy-five in One

How many engineers can take the time to read twenty-five technical magazines every month? Not many, we will wager, because there are too many things in this modern world of hustle that demand our attention. Few engineers work in such a narrow line of their profession that they are able to keep in touch with all the developments even in that line.

This month's issue of the "Water Wheel" contains the most valuable information on water supply and purification furnished by seventy-five different articles, abstracted and digested for your benefit and put before you in such a way that in less than an hour you can be conversant with the doings of the previous month in this important field. Moreover, through the references given, you can find the complete information on any subject that claims your attention.

Jack Hinman is doing a great deal for the water works fraternity by his thorough and painstaking work in this department.

THE READERS' PAGE

More Welcome Suggestions From Readers

Complying with the request made in your letter of January 15, I have reviewed the twelve issues of PUBLIC WORKS for the year 1930, in order to gain a more comprehensive idea of the contents of this volume than was possible from a month-to-month perusal. From this survey, I have concluded that you have covered the field of public works construction in a thoroughgoing manner, hence I can offer no criticism, constructive or otherwise, in this matter.

Your general index in the December issue was particularly valuable, inasmuch as it makes the issues concerned an excellent reference library. Have you considered preparing a general index covering issues for five or ten years? It seems to me that such an index would be invaluable in further extending the "reference library" idea, and thus be of great value to engineers who are engaged in the design and construction of public works.

The past year has witnessed much agitation for changes in methods of financing public improvements. This demand has been strongest in centers of population that have shown the most rapid growth during the past decade. Legislation is now pending in Sacramento which may have a profound effect upon the public improvement programs in California, and particularly upon the southern part of the state where cities are expanding at phenomenal rates. In view of this, it occurs to me that articles dealing with this topic, and possibly an open forum, would be of great value to your readers.

Yours truly,
J. J. JESSUP, City Engineer, Los Angeles, Calif.

In reply to your inquiry as to what we think of the PUBLIC WORKS magazine, I am pleased to state that in our opinion it is a very wide awake and progressive publication, interesting to the average public official and instructive to the public works official.

Without any attempt to criticize your publication in any way, I would suggest that whenever a paper is sent in covering some phase of public works, it should give accurate data on quantities, costs and kinds of material used whenever it is practical to do so. Only then is such a paper a real help to your subscribers.

The article on "Low Cost Residence Streets," appearing in your January,

1931 number, is a good sample of what I mean.

Some of the subjects we should like to read more about are as follows:

1. Collection of ashes, garbage and refuse, and the disposal of same.
2. Sewage disposal, including trade wastes.
3. Gasoline stations.
4. Traffic regulations.
5. Oiling streets.

Thanking you for this opportunity to express our opinion of your publication, I am.

Very truly yours,
BOARD OF PUBLIC WORKS,
Philip A. Merian, City Engineer.
New Britain, Conn.

I receive four engineering and construction journals, and it has been noticeable to me that PUBLIC WORKS seemed to meet the requirements of the average engineer better than the others because it covered the whole field in a simple way.

The articles mostly have not been over the head of the small town or country engineer and have been experiences of others in the same fields and on the same plane that we work or that we are developing into.

The great feats and gigantic accomplishments, I think, are by most journals given too much space in details which but few ever will encounter in a life time; so I say the common everyday problems as we progress, and the best that is adapted to their sturdy growth, is what a journal should give the most space to.

Yours very truly,
H. R. COVINGTON, City Engineer,
Canton, Miss.

"Would like to see some articles on sewage screening incineration, if any are available." L. R. Walker, Ass't. City Engineer, Santa Barbara, Calif.

"Our primary interest is in articles on Water Supply Purification. For example, under the heading 'Purification' on page 29 of the January issue, the use of activated carbon is discussed. A few weeks ago, we used *Nuchar* for the removal of taste, and we expect to repeat the experiment when the Mississippi breaks up in March. We are also interested in 'Legal Decisions,' and as we are tearing up the streets constantly, we have to pay some attention to your articles on highways and pavements." Frank Lawlor, Citizens Water Co., Burlington, Iowa.

"I think the articles on smaller projects are more within the scope of the activities of the average engineer and, therefore, are of more practical value to this type of reader." Leon Luke, Engineer, Macomb County Road Commissioners, Mount Clemens, Mich.

"I am particularly interested in water and sewage. The problems of the smaller towns are of particular interest." A. C. Stanfield, City Engineer, Pana, Ill.

"I would like to know how the other fellow solved his problem." A. H. Bucklin, Sup't. of Water & Light, Burley, Idaho.

"Some stress should be laid on the use of electric thawing of lead and copper pipe in relation to iron." R. C. Bollier, Water and Sewage Sup't., Alamosa, Colo.

"The article by Mr. Bruce of the Bureau of Public Roads was quite interesting and resulted in our getting out a standard plan for superelevation." D. Y. Bate, Van Nuys, Calif.

Water Works Superintendents' Opinions Are Requested

It is the practice in many cities, when they propose to pave a street, to require the water department or company to make a service connection and carry same to the curb line opposite each lot or probable location of building on such street; the service remaining plugged until the near or distant or never-arriving future when it is needed.

For example, the report in 1930 of the Columbus, Ohio, Division of Water gives the number of active services at the end of the year as 59,508, and the unconnected services, installed in advance of paving, as 14,163. As only one to two thousand services are added in a year, it would require about ten years to put all these into use even if not another corporation cock was inserted in the mains. If we allow \$10 as the cost of a service carried to the curb, then Columbus has \$141,630 invested in non-productive installation. Then there is the possibility that an unknown number of these services are leaking—a kind of leak that is very difficult to detect.

On the other hand, it is unnecessary to cut into the pavement to install a service where these pre-connected services are available.

Is this practice worth while? We would like to hear what water works superintendents think. Their replies will be published on the Readers' Page.

Brunswick, Ga., Makes First Installation of Proposed Standard Street Cleaning Recording and Accounting System

IN our issues of November and December, 1930, we abstracted at some length a report of the Committee on Uniform Street Sanitation Records proposing units for measuring work done in street cleaning, removing and disposing of refuse, and cleaning catch basins. This committee primarily represents the International Association of Public Works Officials (formerly the International Association of Street Sanitation Officials), but other organizations engaged in this field are represented on an advisory committee, namely: the National Committee on Municipal Standards, the International City Managers' Association, the American Society of Municipal Engineers, the Governmental Research Association, the American Society of Civil Engineers, the American Municipal Association, the American Road Builders' Association, the National Municipal League, and the American Public Health Association. Joseph J. Petranek is chairman of this committee. The work is financed and staffed by the International City Managers' Association through funds made available by The University of Chicago and the Julius Rosenwald Fund.

Following the publication of this report, the committee decided to try out the system in a city in the 15,000 population class, and, after a survey of such cities, accorded the honor to Brunswick, Ga., because that city is performing all types of activities, including street cleaning; the removal of garbage, trash, night soil, and dead animals; incineration, dumping, catch basin cleaning, and other services included in the committee's program and usually supplied only in larger cities. Moreover, the methods employed by City Manager E. C. Garvin in administering these activities, together with his budget system, are of such excellence that an installation of the committee's system could be made with relative ease.

(Mr. Garvin has written for PUBLIC WORKS a description of the methods of collection and disposal employed at Brunswick, which description appears elsewhere in this issue.)

During the three weeks of residence in Brunswick, the staff, consisting of Donald C. Stone and G. A. Moe, not only installed the standard work units proposed by the committee, but also set up unit cost standards for each activity and prepared a work program for the current year. The installation consisted of introducing the following:

(1) Daily field reports for all work performed and equipment used.

(2) Equipment records showing the performance and costs of operating each piece of equipment.

(3) Cost records by means of which the daily field reports, equipment records, and other accounting forms can be compiled into total and unit costs of the work done.

(4) A complaint procedure insuring that every complaint will be investigated with dispatch.

(5) Monthly statements of work and costs, of man hour production, of services performed, and of complaints; showing in each case how accomplishment compares with a predetermined standard.

The system installed in Brunswick employed the work units which the Committee on Uniform Street Sanitation Records recommended in its report and which were explained fully in PUBLIC WORKS of last November.

Work Program and Unit Cost Standards

A work program for the entire year was prepared for each of the above activities. This work program shows the total work for each operation to be done during the year expressed in terms of work units, unit cost standards, and total cost. The amount of work to be done was based on an analysis of the present schedule of operations and the estimates of the city manager and street and sanitation superintendents. Schedules of sizes of routes and frequency of work therefore support Table I.

The unit cost standards represent the minimum unit cost at which Brunswick may be expected to perform its work. Thus, they may serve the officials of Brunswick as a standard throughout the entire year to guide them in evaluating actual performance. It was necessary to post all of the records from January 1 to the time of the installation in order to set up these unit cost standards. The total costs on the work program were then computed by multiplying the unit cost standard by the amount of work to be done. Ordinarily many of the unit cost standards should vary from month to month, but the system must operate a year or two before such refinements can be attained.

During the course of the year, a monthly work and cost statement will indicate whether the work program is being complied with and the extent to which actual unit costs conform to the unit cost standards. This monthly statement provides the city manager and the street sanitation officials with a control over each of the operations listed. If the work or unit costs do not conform to the estimates and standards, the de-



At left—Marsh dump covered. Fly trap in foreground.

Below—Auto graveyard. Debris on edge of fill before removal to bottom of canal at left and before covering.



TABLE I—SCHEDULE A—WORK PROGRAM FOR 1931

Operations (1)	Standard Units employed (2)	Total No. Work Units (3)	Unit Cost Stan- dard (4)	Total Cost (5)	January (6)		February (7)		March (8)	
					No. Work Units	Cost	No. Work Units	Cost	No. Work Units	Cost
1 Refuse RemovalCubic Yds.		55000	.30	\$16,500	4500	1350	4000	1200	4200	1260
2 Night Soil Removal.... "		1335	1.50	2,002	125	187	110	165	100	150
3 Incineration "		10600	.15	1,590	900	135	800	120	900	135
4 Dumping "		45535	.04	1,829	3725	149	3310	132	3400	136
5 Machine SweepingCling. Mile		1105	1.00	1,105	110	110	100	100	100	100
6 Beat Patrol "		2880	.40	1,152	240	96	240	96	240	96
7 Sweepings RemovalCubic Yds.		940	.15	141	100	15	100	15	100	15
8 Catch Basin Cleaning... "		400	1.00	400						

The program was continued for the entire 12 months, which are not included in detail above, but the units were estimated as follows, applying to the remaining nine months in the order given: Refuse removal—4800, 5000, 4500, 5500, 5000, 4000, 5000, 4000, 4500. Night soil removal—125, 125, 100, 125, 100, 100, 100, 100, 125. Incineration—1000, 900, 900, 900, 800, 900, 800, 900, 900. Dumping—3,925, 4,225, 3,700, 4,725, 4,200, 3,300, 4,200, 3,300, 3,725. Machine sweeping—100, 100, 85, 85, 85, 85, 85, 85, 85. Beat patrol—240 each month. Sweepings removal—90, 90, 80, 70, 70, 60, 60, 60, 60. Catch basin cleaning—200, —, —, 100, —, —, 100, —, —.

COMPARATIVE WORK AND COST STATEMENT
for
STREET AND SANITATION DEPARTMENTS

City of Brunswick		For Month Ending _____ 1931								
Operation (1)	Work Units (2)	Units of Work Done			Unit Cost			Total Cost		
		Actual Work (3)	Program Estimate (4)	Dif- ference (5)	Actual (6)	Standard (7)	Dif- ference (8)	Actual (9)	Program Estimate (10)	Difference (11)
Sanitary Department	Cubic Yards									
Refuse Removal										
Night Soil Removal										
Incineration										
Dump Disposal										
Sanitary Dept. Totals										
Streets and Drains	Cleaning Miles									
Machine Sweeping										
Beat Patrol	Cu.Yds.									
Sweepings Removal	Cl.Miles									
Street Const. & Cleaning	Miles									
Street Grading										
Street Repaving	Sq. Yds.									
Sewer Work	Lineal ft.									
Catch Basin Cleaning	No.Basins									
Ditching	Lineal ft.									
Streets and Drains Totals										

tailed cost records are analyzed to determine the cause therefor. The schedules of work or methods can then be revised on the basis of the facts provided by this installation.

Control Over Complaints and Special Services

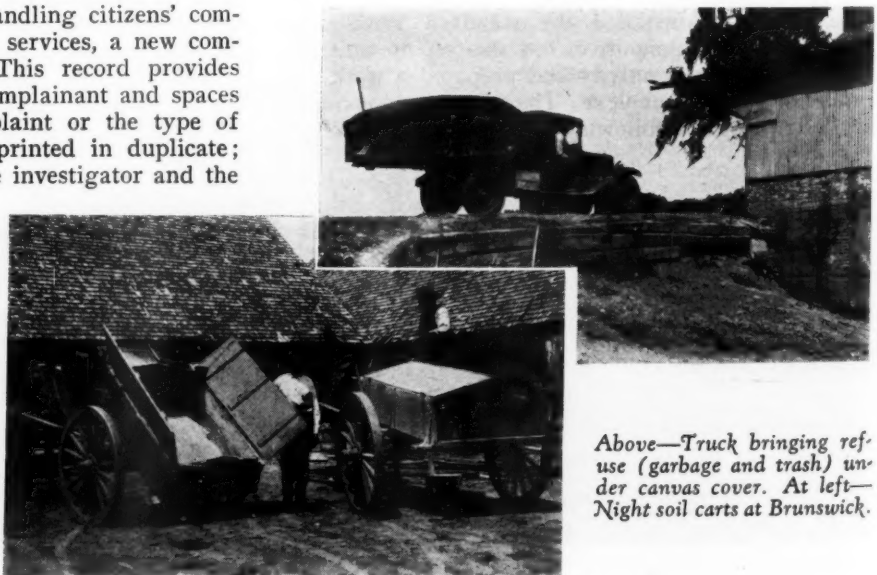
To improve the method of handling citizens' complaints and requests for special services, a new complaint record was installed. This record provides the name and address of the complainant and spaces for checking the type of complaint or the type of special service. The form is printed in duplicate; the first copy being given to the investigator and the second remaining in the office as a control. If it was a citizen's complaint, the investigator will state in detail, in the space provided, who was at fault and the action taken.

At the end of the month, these complaint reports will be compiled and entered on the Analysis of Complaints and Special Requests for Service. This analysis not only separates the special services from actual complaints, but

shows the cause of complaints and whether they are justified. With this analysis at hand, the officials will have a barometer of citizen satisfaction with their work and will be able to identify the causes of complaints.

ANALYSIS OF COMPLAINTS AND SPECIAL REQUESTS FOR SERVICE

City of Brunswick		For Month of _____ 19__	
Sanitary Department			
NATURE OF COMPLAINT		RESULTS OF INVESTIGATION	
1. Failure to collect refuse		Justified Complaints	
2. Careless of unsanitary handling		1. Collector failed to stop	
3. Discourteous acts by collector.		2. Refuse not properly removed.	
4. Personal property taken by collector.		3. Collector discourteous	
5. Other		4. Collector took property not on refuse pile	
TOTAL		5. Other justified causes	
		TOTAL	
SPECIAL COLLECTIONS REQUESTED		Unjustified Complaints	
1. Garbage		6. Refuse improperly located.	
2. Trash		7. False Complaint	
3. Ashes		8. Property carelessly left on refuse pile.	
4. Dead Animals		9. Proved to be request for special collection.	
5. Other		10. Other unjustified causes.	
TOTAL		Total unjustified complaints.	
		Total Complaint Investigations	
Comparison of Complaints		This Month	Last Month
Justified			
Unjustified			
Total			



Above—Truck bringing refuse (garbage and trash) under canvas cover. At left—Night soil carts at Brunswick.

Highway Policies in Several States

What the governors of the states said in their annual messages concerning low cost roads, gasoline taxes, state aid for city streets, finances, unemployment and other features of highway progress

HIGHWAY progress and policies relative thereto naturally occupied prominent places in the messages which the governors of the several states addressed to the state legislatures the early part of this year. Of the several phases of the subject touched upon by the different messages, we find low-cost roads, gasoline taxes, state aid for city streets, and aid for non-employment to be the most prominent.

Low-Cost Roads

Arkansas.—"The State highway system has now progressed far enough that I believe we should turn increasing attention to development of roads which will permit the farmers of this State to get to the State highway system and get full advantage of it. To this end, I am working on a plan for county road development."

Connecticut.—"A most pressing need also is a comprehensive plan for the building and the improvement of rural roads. The time has come, in popular phrase, 'to take the farmer out of the mud.' During the winter months many of the rural roads are impassable by automobile and very few of them are ordinarily in good condition. The ideal towards which we should strive is a complete network of good roads from all villages and outlying districts, tied in with the State roads and trunk lines, so that all parts of the State may be readily accessible to farmers and city dwellers alike. I await in pleasant anticipation an opportunity to approve a bill for rural roads such as you may agree upon for the purpose by a proper allocation of the income from the gasoline tax and motor-vehicle registration fees."

Delaware.—"The years '29 and '30 mark the beginning of dirt road improvement and maintenance by the State Highway Department. Twenty-three miles of this class of work has been undertaken and is being economically and satisfactorily maintained."

Iowa.—"In continuing with our road building program, we must ever keep in mind that the benefits to our people, for whom the roads are established and maintained, must be properly apportioned. The construction cost of the main arteries of travel is necessarily high. It will be found to be impractical and financially impossible to carry that class of construction beyond the main channels of travel and down to every community entitled to improved roads. Therefore, some less expensive plan of surfacing must be employed on many of the roads in order that a more complete system of serviceable, all-season roads may be built. The value of good roads, universally acknowledged, will be more apparent when a system of all-weather highways connect farms with markets, and communities with those centers of trade and the main arteries of travel to which they desire access."

Kansas.—"There is considerable sentiment in this State for a change to the construction of more miles of hard-surfaced roads. . . . However, we must first 'walk before we run.' Kansas is an agricultural State with many sparsely settled sections. We do not have the dense population, the wealth or public revenue of

States which are used for comparison. To attempt to immediately hard-surface the main highways of our system would be unsound and indefensible from any viewpoint. . . . The people of Kansas were assured that the State would institute and push to conclusion a State system of all-weather roads. Only half of the system is now completed. . . . We must continue the construction of some hard-surfaced roads to close gaps and take care of special conditions where the heavy traffic makes the cost of maintaining and resurfacing the present roads prohibitive, but we should not abandon the original pledge made to the people of Kansas."

Nevada.—"It is a pleasure to state that within the short period of three years the Department has oil-treated 513.12 miles of gravel surfaced roads, and this treatment is not only relieving the dust nuisance and loose gravel hazard, but is saving the State thousands of dollars annually in gravel and binder loss, besides a large saving in maintenance costs."

Ohio.—"The financing of rural roads also deserves legislative attention. The efficiency and safety of intercity transportation require the continuance of the present revenues for the present State highway system. At the same time the campaign against mud roads in the rural communities must continue. I recommend, therefore, that a secondary system of State highways be organized to include all local roads which have sufficient traffic to justify the Highway Department in including them in this system, thus enabling county and township officials to extend the improvements into remoter sections and getting more of our rural population out of the mud."

Pennsylvania.—"Much study has been devoted to the classification of township roads. Department engineers, with the assistance of the local boards of road supervisors, have mapped a system of township roads throughout the State, divided into three groups in order of importance, designated as primary, secondary, and useless. It is expected this study will be of great importance in determining future legislation and policy in its relation to reward roads."

"For lack of a logical plan of improvement, the township highways have grown into an irregular and disconnected system. That condition is thoroughly unsatisfactory. In place of it there should be substituted a planned and orderly system of inter-county and inter-township roads. . . .

"In view of the unprecedented size and importance of the task of taking over at one time, and afterward maintaining and improving, so large a mileage of roads, I am emphatically of opinion that the responsibility of the Highway Department should not, at this time, be increased by adding to the 20,000 miles of township roads, or by including roads within the boundaries of boroughs, or otherwise augmenting a piece of work already great and difficult beyond all precedent. . . .

"For the same reason of limitation of funds I believe that it will not be feasible to find money for State aid and township reward. In offset, however,

it is conservatively estimated that the taking over of 20,000 miles of township roads on which this money would ordinarily be spent will result in a net saving to the townships of \$10,000,000 a year. That is help of the most practical sort."

South Dakota.—"I am not opposed to paving where it is needful, but feel that it should be rigidly confined for the time being to short sections where paving is undeniably less costly than other types of highway construction, maintenance costs considered. And I would further limit this construction to such mileage as we can comfortably finance without injustice to other sections and other groups equally deserving. . . . I would recommend that greater attention be directed henceforth to farm-to-market roads."

Gasoline Taxes

Alabama.—"A law raising the gas tax one more cent for State road purposes and limiting the total for all purposes to not exceeding six cents per gallon would in my judgment be wise."

Arkansas.—"The Highway Commission can and should concentrate its effort upon permanent pavement on the important through roads, to reduce the heavy maintenance cost and to increase the revenues from gasoline tax and license fees."

"Our theory of taxation for road purposes is that a man pays an automobile license fee as a ready-to-serve charge for use of the roads. He pays this fee if he uses the roads at all, regardless of how little. Then the gasoline tax is a metered tax which he pays depending upon the extent to which he uses the roads."

Illinois.—"I urge most strongly that the present sources of highway revenues be not diverted to other uses until this pledge has been fulfilled."

Indiana.—"It is easy to see that any diversion or depletion of the regular highway construction and maintenance funds must destroy the road program, disrupt the organization, slow down the good roads movement and hamper a service which is making itself indispensable and which is urgently demanded by the public. All moneys collected as gasoline taxes and automobile license fees should be expended upon our roads in justice to the public."

Iowa.—"All of this vast improvement has been carried out without increasing the tax levies. In fact, the tax on real and personal property for primary roads has been removed. The burden has been shifted from property owner to the road user. The entire bill is being borne by the gasoline tax and motor license fees, except that a small percentage comes from Federal aid. The property owner pays nothing."

"We have adopted the plan of paying the cost of our primary roads from funds contributed by the people who use them. We must steadfastly hold to this plan. It was on this solemn promise the various counties furnished the funds to make possible the great achievement in highway improvement. By this token we shall vigorously oppose any effort made to divert primary road funds from the purposes now defined in the law. It is our absolute duty to use every safeguard insuring property owners that the cost of these improved highways shall never result in a tax on property."

Maine.—"Road improvement must be paid for and the citizens of the State, by rejecting at a referendum vote an increase in the gasoline tax, have indicated

that the desire for improvement is not so general as is represented by some enthusiasts."

Maryland.—"In the past, State bonds have been issued each year to match the Federal aid received from the Government. The normal increase, however, in the receipts from automobile licenses and gasoline taxes justifies, I think, a change in this method of financing, and I am now recommending that the above Federal aid be matched each year from the license fees and gasoline taxes. This will relieve the general taxpayers of the State of a bond issue of \$1,052,000 each year and will place the cost of matching the Federal road money upon those who use the roads."

Montana.—"The Montana Automobile Association, on the recommendation of the State Highway Commission, has prepared a bill that will be introduced immediately, providing for the sale of \$6,000,000 of anticipation gasoline tax warrants during a period of four years, underwritten by a portion of the gasoline tax and following a plan that has been used in New Mexico, Idaho and several other States."

Nevada.—"Inasmuch as there is an immediate need for a far reaching and comprehensive highway program for the coming two years to relieve the unemployment situation, as well as to use the Federal Aid available for highway improvements, I recommend that all revenues derived from the motor vehicle license fees and the gasoline tax be used for the completion and maintenance of our Federal Aid and State Highway system, and that no diversion of these funds be made for other purposes."

North Dakota.—"How shall new construction work be financed? * * * In my judgment, the proper way to solve the problem is to provide for an increase in highway revenues on motor traffic entirely, and to that end I would advise the following legislation:

"First: Raise the State gasoline tax by 1 cent per gallon, the collection to go to the State highway construction fund after deducting the usual refunds for gasoline used in tractors and stationary engines.

"Second: Provide a moderate increase in motor vehicle registration fees.

"Third: Correct, if possible, the defects in the present system of allowing refunds, in order to reduce the frauds that it seems certain are being practiced against the State, and thus save to the State a larger share of gasoline tax collections."

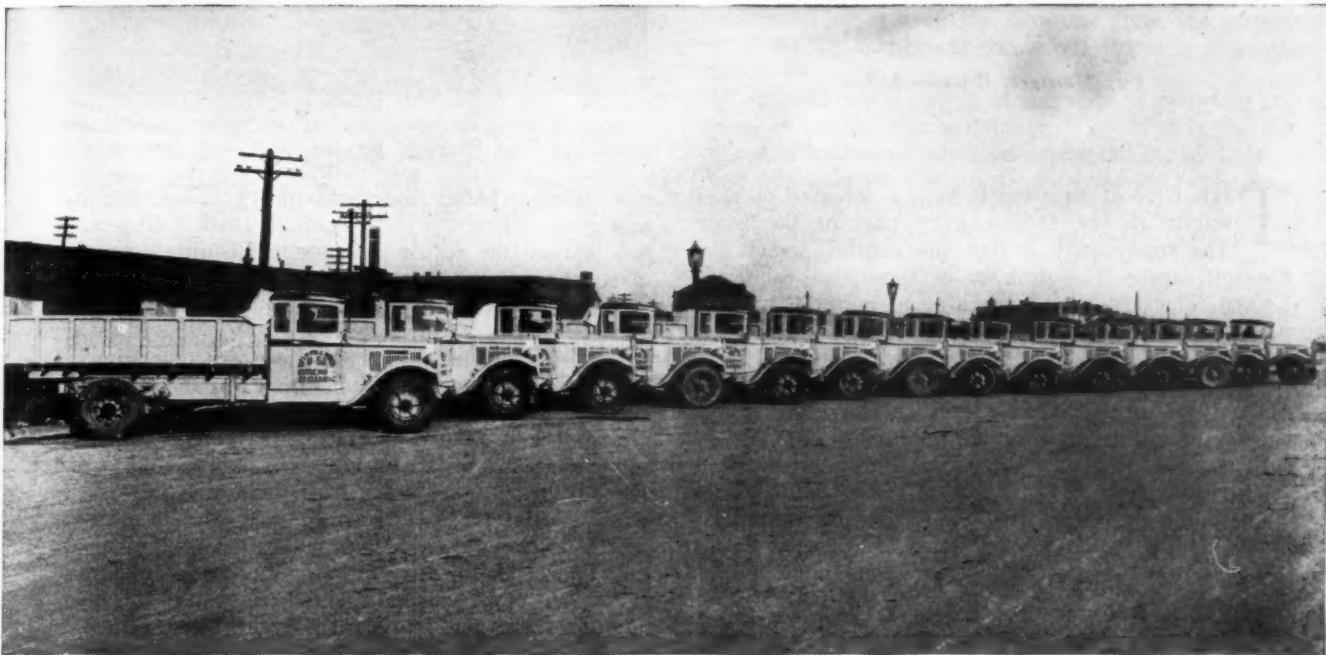
South Dakota.—"While good roads are an asset to our State, we must not spend beyond our means. I would recommend that suitable legislation be enacted to apportion fairly the funds derived from the gasoline tax and the automobile licenses between the State and the various counties, to the end that construction of both our State highway system and a secondary road system may be forwarded as rapidly as possible."

Utah.—"The suggestion is occasionally made that a portion of the gasoline tax revenues be used for general State purposes. Inasmuch as we have strongly pressed for increased Federal aid for the construction of our main highways, I feel that the State of Utah would stultify itself if it were to divert any portion of its own road moneys to other uses. * * *

"When it becomes possible to get along without all of the gasoline tax for the present State road system, that system should be enlarged to include some of the

(Continued on page 74)

. . . FOR BIG LOADS, HEAVY LOADS, YOU NEED HEAVY-DUTY TRUCKS



A fleet of Heavy-Duty Dodge Trucks now serving the Department of Public Works, Philadelphia, Pennsylvania

For heavy-duty hauling you need trucks that will haul heavy loads. » » Dodge Heavy-Duty Trucks will do that. They are rugged in design and construction through and through. Everything about them says *heavy duty*. Everything about them says *power*, says *dependability*, says *long life at low cost*. » » Whatever your heavy-duty hauling needs may be . . . whether you must head up steep hills often or over unimproved roads daily . . . there is a Dodge Heavy-Duty Truck for your job. A Dodge Truck that's modern. That's precision-built throughout and correctly balanced part to part for longer life. A truck that's dependable. That's economical. That will work for you and earn for you as no

other truck will do. » » See your Dodge Brothers dealer. See and test the Dodge Heavy-Duty Truck that fits your needs. You can buy it complete with standard or special body. You will find it an exceptional value—a loyal worker, a consistent earner.

THE COMPLETE LINE OF DODGE TRUCKS RANGES IN PAYLOAD CAPACITIES FROM 1,200 TO 11,175 POUNDS—PRICED, CHASSIS F. O. B. DETROIT, FROM \$435 TO \$2695, INCLUDING THE 1½-TON CHASSIS AT **\$595**

TO HELP LOWER YOUR HAULING COSTS OPERATING RECORD BOOK FREE

DODGE BROTHERS CORPORATION
Detroit, Michigan

A-41

Send your Operating Record Book. I understand there is no obligation.

NAME _____

ADDRESS _____

CITY _____ STATE _____

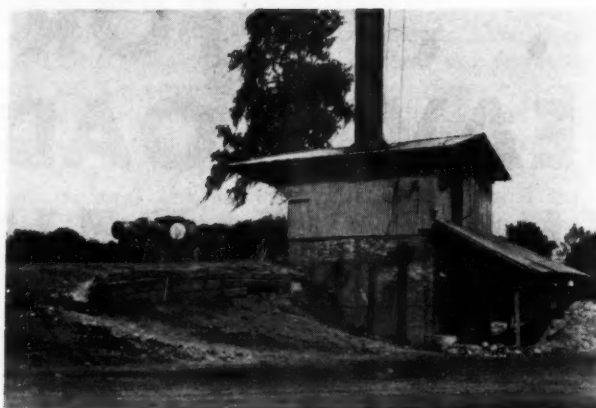
Number of Trucks Operated (Book for each will be sent) _____

DEPENDABLE DODGE TRUCKS

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 95

Refuse Disposal and Street Cleaning at Brunswick, Ga.

By E. C. Garvin
City Manager, Brunswick, Ga.



Ten-ton Nye incinerator. Drums on ramp contain disinfectant. Pile of shavings for fuel shown at extreme right.

THE City of Brunswick, Ga., is situated on tidal waters in the south-eastern part of the State. The topography is flat, the rainfall heavy and the soil sandy. The problem of snow removal is unknown. The city has been operating under City Manager form of government since 1921. The present population, based on 1930 census, is about 15,000, of which approximately one-half is colored.

For convenience in administration, the public works department is divided into two parts, known as the Sanitary Department and the Department of Streets and Drains. Each is now in charge of a foreman. For the purpose of economy, the office of director of public works was abolished by the commission about a year ago. The economy program reached much deeper, as may be seen by the budget table below. The actual curtailment of expenditures began in 1929.

PUBLIC WORKS BUDGET

	Sanitary Department	Department of Streets & Drains	Total Bud- get, Public Works	Total Amount Spent, Public Works
1928	27,700	33,900	61,600	70,904 (1)
1929	34,520	41,693	76,213	66,145
1930	26,640	31,100	57,740	54,809
1931	23,050	23,934	46,984	

(1) Increase due largely to removal of debris resulting from storm (tail end of Florida hurricane.)

Collection

About 80% of the population is served by sewers, the remaining 20% by night soil collection. One-mule, wooden carts with hinged covers are used for this purpose. All of the night soil is disposed of at the incinerator.

The collection of garbage and trash is made largely with motor equipment, two men to the truck, and each truck of one and one-half cubic yards capacity. The trucks are equipped with canvas covers to prevent the loss of material and to hide their contents from sensitive eyes. As these are somewhat troublesome to use, their constant application is difficult to enforce. The acceptance of monetary tips by the collectors is prohibited, but no doubt this practice continues to some extent in defiance of precautions. The acceptance of old clothes, bottles, etc., is permitted. Many amusing incidents occur in connection with this custom. One housewife called on her neighbor for the usual morning gossip. Standing in the back yard, arms akimbo, the discussion waxed warm in the summer heat. She removed her hat and rested it on top of the garbage can near by. When the argument

was concluded and household duties called, her hat was gone. From the investigation which followed, it was learned the refuse collector had emptied the can, taken the hat and departed rejoicing in the belief that the housewife had made a small contribution in appreciation of faithful service.

Generally, collections are made every other day (3 collections per week). Hotels, boarding houses, markets, etc., are served every day. Special service is rendered any time, any place, on request. The law requires metal containers with tops, for garbage; and substantial containers for trash; but this law is not strictly enforced. Where conditions seem to warrant among the financially incompetent, the city furnishes free of charge large metal drums donated by a local industrial plant which has no further use for them.

Efforts are made to persuade the householders to drain and wrap garbage before placing it into the can. On the running board of each truck is carried a large container of disinfectant, which is applied to the can after emptying as the need requires. The top is left off and the can placed in the sun for airing when the weather permits.

Where property has back alley frontage, collections are made from the rear, the can being placed generally just inside the fence or property line. Property without alley abutting is served from the front, the can being placed in the rear of the house. Attempt is made to keep garbage and trash and their containers off the public ways. It is believed the additional expense is fully justified by the improvement in appearance.

While the foreman in charge of this work claims that each truck has a definite district to cover and a definite route to follow, which are so defined as to render maximum service at minimum expense, the City Manager will remain unconvinced until these features are clearly shown by appropriate spot maps whereby the claims may be compared with the facts.

Disposal

The incinerator was built in 1918 at a cost of \$6,000. It has a rated capacity of ten tons per 24 hours, but is not operated at night. All dead animals and about 25% of the garbage and trash are disposed of at the incinerator, the remaining 75% at the dump. The incinerator is strictly a one-man affair. The operator not only attends to all the duties connected with its operation, but also takes care of the mules, does odd jobs of repair work on the collection carts, gives

occasional attention to the city nursery located at the plant, and finds time to raise a garden and rear a family of his own on city property which he occupies as part of his compensation. Only on the rarest occasions is fuel purchased for the incinerator. A supply of shavings, obtained for the hauling from nearby mills, is kept on hand for rainy weather and the fruit season. No profit is derived from the operation of the incinerator. The resulting ash and clinker are used in filling depressions in unpaved streets and potential mosquito breeding areas.

Notwithstanding its isolated location and the reasonable care used in covering, the city dump is still just a dump. A salt water marsh of several thousand acres, bordered by an abandoned canal, is used as the dumping ground. Autos and trucks are dumped in the bottom of the canal, which is deep enough to bury them completely when covered to grade. One man is maintained at all times on the dump. He is assisted by the truck drivers and helpers on their last load for the day. The amount of assistance thus received is determined by the length of otherwise idle time between the hour of arrival at the dump and the hour due for the night at the garage. Should the dump get beyond control for any reason, as much as may be necessary of the force of the streets and drains department is detailed promptly to correct matters.

Large fly traps are maintained at the dump. In the event the flies make any headway, a few days spraying with kerosene will usually bring them under control. Spraying may even be extended to infested private property where the conditions contributing to fly breeding can be so mended. Fortunately, this service to private property is rarely needed.

Street Cleaning

Many alleys are too narrow to permit the use of mule or tractor drawn mowing machines, and during the growing season some of the men engaged in refuse removal are temporarily detailed to cut and remove the weeds and other growth from narrow public ways. The additional hours worked, if any, are paid for at the regular hourly rates for the respective employees.

The department of streets and drains is, as the name implies, concerned with everything connected with streets, storm and sanitary sewers, pumping stations, ditches, etc. While each kind of work engaged in by this department requires special knowledge, skill and experience, necessity compels the use of the same men on all. For the purpose of this article only street cleaning is pertinent.

One motor pick-up sweeper is used. It operates on about 12 miles of pavement, partly of brick and partly of asphaltic surface, ordinarily covering the entire route in a single night. The down-town business area is patrolled by two men with push carts and cans. They are old, faithful darkies who have long since outgrown their usefulness in the field to which they were formerly assigned. They take much pride in their work, and really keep this district unusually clean.

The sweeper loads are dumped at convenient places along the route, where trucks on special duty pick them up. The material collected is used for filling depressions in parks and unpaved streets nearby and in covering the dump. Contrary to the usual habit of trees, the live oaks, of which there are many along

the paved streets of Brunswick, shed their leaves in the spring instead of the fall. Otherwise street sweeping is no more seasonal here than elsewhere.

None of the streets are cleaned by mechanical flushing of any kind. After each rain of any consequence (and in the rainy season heavy rains are frequent) all catch basins are cleaned by hand, two men and a truck being thus engaged. Though street grades are flat, the material washed and blown in from planting strips and unpaved intersecting streets is very light and easily transported by wind and water. Quite aside from the attractiveness of clean streets, it is more economical to remove the material from the gutters by sweeping than from the sewers after a stoppage occurs.

Two men are engaged at the sewage pumping stations, which are semi-automatic. The chief is the day man, the assistant being on at night. In addition to their plant duties, these men, with one mechanic assistant, keep all the motor equipment rolling. The repair shop and the garage are adjacent to the main pumping station.

The Committee on Uniform Street Sanitation Records, Louis Brownlow, chairman, Research Committee of the International City Managers Association, recently completed an installation at Brunswick of standard units of measurement and cost for street cleaning, refuse removal and disposal, under the immediate direction of Donald C. Stone, research director. This is now in full operation. It is too early to appraise its practicability and value. (The system is described elsewhere in this issue.)

Preventive Street Cleaning

The daily cleaning of a great city is by no means a small task, but is a problem involving the employment of a trained organization and the expenditure of a large sum of money.

The promiscuous littering of the streets by thoughtless citizens is perhaps the most difficult problem to contend with; while there is a city by-law prohibiting the throwing of waste upon the streets, and the overloading of vehicles to such a point that the material falls to the roadway, it is probably violated several hundred times a day without interference.

A newspaper carelessly discarded and separated by the wind will make a whole neighborhood appear relatively dirty, whether it is or not. The distribution of hand bills, circulars, and weekly district papers are invariably carelessly thrown upon verandahs and steps, to the mercy of prevailing winds, and finally deposited upon lawns and boulevards, or lodged in shrubbery.

Street dirt is divided into two general classes: Natural, and therefore unavoidable, and that due to carelessness, therefore avoidable. The real duty of the department is the removal of the first class, but in so doing is compelled to sweep up and remove the material of the second class.

The preventative side of street cleaning work has in recent years been given particular attention with a view to reducing avoidable litter to a minimum. The distribution of notice cards, detailing the various requirements of the by-laws and a closer relation with the department of public health, has attained results as well as stimulated the co-operation of the public generally.

From report of George W. Dies, Street Commissioner of Toronto, Ontario.

Good Management in Road Building

GOOD MANAGEMENT in the building of roads and pavements requires careful attention to cost of and interest on investment, cost of maintenance, earning power and returns from the roads.

By building Low Cost Roads the saving in interest because of the smaller investment, and the comparative high earning power of such roads, will more than pay for such roads.

And Low Cost Roads can be so constructed as to have every desirable quality — smooth, easy riding surfaces, flexibility and durability.

STANDARD OIL COMPANY

(INDIANA)

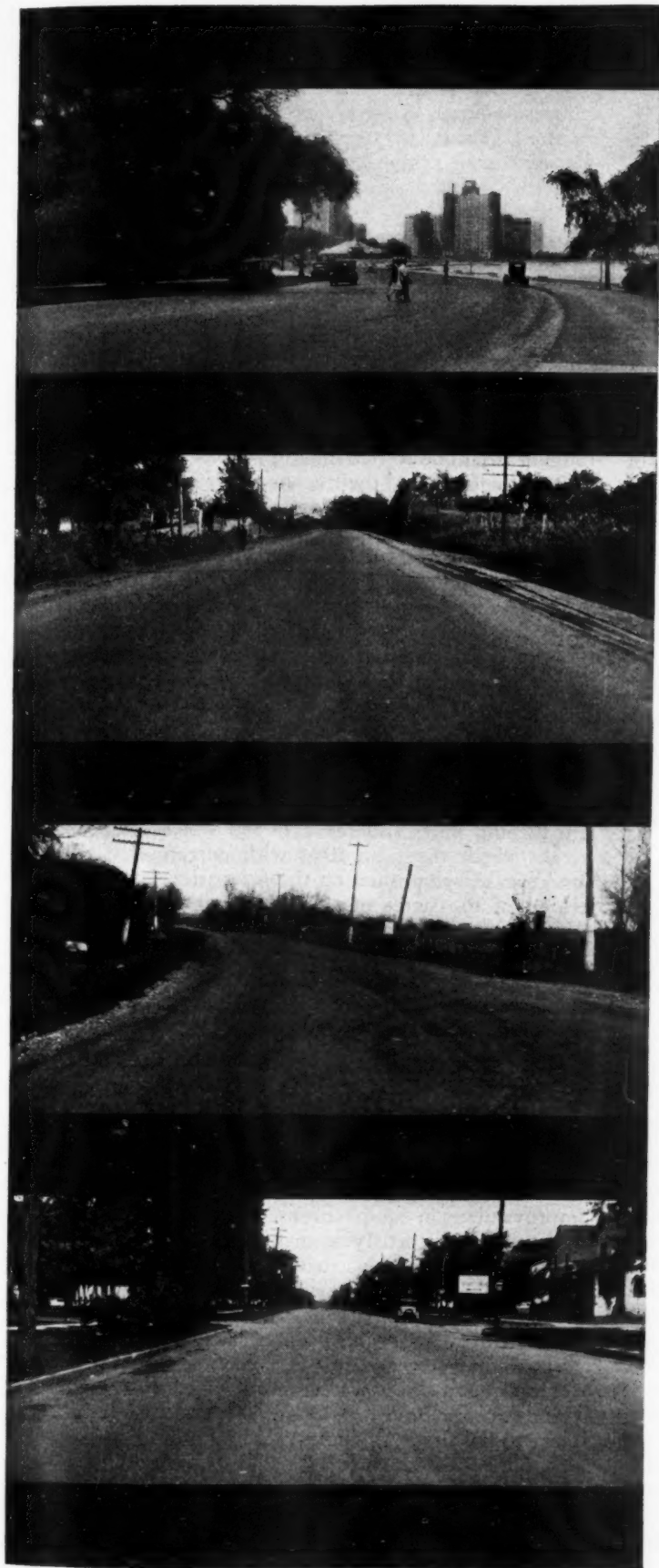
910 S. Michigan Avenue

Chicago, Illinois

Billings	Decatur	Duluth	Huron	Mankato	Saginaw	South Bend
Cheyenne	Denver	Evansville	Indianapolis	Mason City	Sioux City	St. Louis
Chicago	Des Moines	Fargo	Joliet	Minneapolis	Peoria	St. Joseph
Davenport	Detroit	Grand Rapids	Kansas City	Milwaukee	Quincy	Wichita
		Green Bay	La Crosse	Minot		105

ASPHALTS

When writing, please mention PUBLIC WORKS



Maintenance as Well as First Cost Is Low on Roads Like These

Roads and pavements built with Stanolind Cut-Back Asphalt not only can be constructed at low cost but because of their durability and resistance to traffic wear can be maintained at a very small expense.

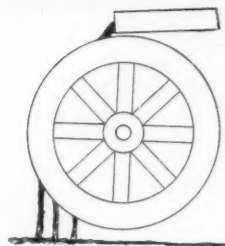
No highway builder can afford to overlook the many advantages of roads built with Stanolind Cut-Back Asphalt—smooth, easy riding, durable, low in first cost, and low in maintenance cost. If you would like further information on Low Cost Roads, write for our Cut-Back Asphalt Booklet. It is a valuable handbook on low cost road building with Asphalt.

FOR EVERY PURPOSE

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 95

THE WATER WHEEL

By
Jack J. Hinman, Jr.



Design

THE adequacy of impounded water supplies depends so much upon the assumptions made with regard to the expected minimum yield per square mile of watershed, that precipitation and runoff values for the area are matters of vital importance. An extensive and valuable study of rational runoff formulas by Gregory and Arnold⁶⁰ may therefore be expected to be useful, especially to designers studying the higher rates of flow in an effort to conserve the maximum quantity of water. It does not necessarily follow that the precipitation records always indicate the effective rainfall, for as Malcolmson⁷¹ has indicated, heavy snowfalls may introduce material errors. Usually measurements give the depth of the snow or the amount of equivalent water. The rate of release of water from the snow blanket should be noted. Many impounded supplies have suffered severe shortages during the summer, and some have entirely failed. Wells⁶² indicates that at least in the Northeastern United States there must be **reservoir capacity** sufficient to provide storage of water for use between June and January. He shows that since 1868 the Croton watershed has supplied water at the rate of about one million gallons per day per square mile of watershed, with a minimum of 560,000 gallons.

Plans to **reclaim sewage** and experiments on the practical phases of the problem attract attention in Southern California,²¹ where the reclaimed water is estimated to have a value of \$55 to \$85 a million gallons. The plans for the **Colorado River Aqueduct** to bring in water for the Los Angeles Metropolitan District² will provide a material increase in the amount of water to be supplied to the great urban development in the same part of the state.

Gravity dams arched downstream is the somewhat unorthodox suggestion made by B. J. Lambert.⁴⁹ D. C. Henry,¹⁸ in a summary of the problems of concrete dam design, calls attention to the advantages of **pre-cast blocks**. In a small rolled earth dam on the campus of Stanford University it was found economical to use a **sloping cut-off wall**²⁹ which required no forms. **Foundation conditions** as shown by 26,000 feet of drill hole exploration required excavation to 125 feet below the stream bed for the new Ariel dam on the Lewis river near Portland, Oregon.¹⁹

The design of the ninety-foot circular **low-lift pumping station** of the new Springwells plant at Detroit²⁵ includes an annular suction and surge chamber surrounding the pump space where eight vertical motor-driven centrifugal pumps will be placed. The total capacity will be 420 m.g.d. It is interesting to note

that Detroit is increasing available storage of water in certain portions of the city by installing elevated tanks.⁶⁰ There will be twelve tanks with capacities ranging from one to two million gallons each.

Diesel engines and their economy of pumping, especially where a number of small units are desirable, has been discussed by R. D. Hall.^{36, 74} The future of this type of equipment seems assured. British ideas in regard to **well pumps** for water works are being set forth at length in a continued paper running in the London magazine, the Engineer,¹³ and a review of water works practice is also available from the same source.²⁷

The site and method of **construction of wells** is discussed by A. G. Fiedler, of the United States Geological Survey,⁶⁶ while M. R. Lewis considers the flow of ground water as applied to **drainage wells**.⁴⁸

According to Harry N. Jenks²⁰ the **mountain supplies** of the western states are **degenerating** and the cities are turning more and more to the waters of nearby rivers which they can treat with current devices at less cost. A symposium on the water developments in eleven of the states of the West, while considering **irrigation** rather than municipal water supply, gives a summary of existing conditions.¹⁷ Rapid surveys of possible **reservoir** sites in the Lower Mississippi region have been made in the states of Arkansas, Louisiana and Mississippi. Fourteen dam and reservoir sites were surveyed and six **economic surveys** of rivers were conducted in a period of 4½ months.¹⁴

Construction

It is reported that the **Hetch Hetchy** tunnel is now sixty percent complete.²⁴ A valuable collection of papers on **tunneling practice** from the standpoint of the improvements in equipment used, summarizes this general subject in a satisfying manner.³⁴

Smaller items of construction include the creation of a 600 million gallon **reservoir** for Attica, New York, with a \$30,000 dam;⁵⁷ a new **sedimentation basin** for Sacramento, California;²⁸ a new **steel water tank** 80 feet in diameter and 42 feet high for Cedartown, Georgia;³ and a new **water supply system** taking water from wells for Bradford, Ontario.¹² Phoenix, Arizona, plans to lay about 3½ miles of 24 inch to 54 inch **pipe line**, 8 miles of 6 inch to 12 inch distribution lines, and to build a new 20-million gallon circular concrete-lined reservoir.³³

The story of the development of the water supply of Independence, Kansas, from its beginning in 1885, is related by the superintendent, J. C. Gordon, who began work at the plant as a small boy under his father. Since 1912 all construction has been financed from earnings.

Management

The month has been productive in papers devoted to the broader phases of water works management. **Avoidance of losses** in the conduct of water supply operations is the topic of a stimulating paper by Frank C. Jordan.⁵⁶ The various phases of endeavor which insure the **successful operation** of a water works was the subject of consideration by R. H. Corey, of Salem, Oregon.¹¹ The part that **politics** plays in reducing the efficiency of many water works properties is presented by F. M. Randlett.⁷⁵ Under the title of "Notes from a Superintendent's Report," W. H. Lawrence, of Kalispell, Montana, discusses for the benefit of his consumers a number of points which affect **public relations**, such as the fundamental justice of universal metering.⁷³ **Preparedness for fire protection** is a matter which requires considerable investment in every water supply project, but how to make existing provisions most effective is not always clearly seen by those in control. Harry J. Corcoran states that cooperation between the fire and water departments and the mutual exchange of information between them are vital.⁶⁷ Scott Johnson⁴³ urges that the water works superintendent consider **his job** and tells how to make out of it something more than many men have thought was possible, both for himself and for the community service.

Accounting for a privately owned water plant is somewhat different from that required for a municipally owned one. Just how those features necessary for the privately owned plants are taken care of, is explained by De Moya.⁴² The legal aspects of property valuation⁶⁵ for **rate making** and the **compensation for land condemned**⁵³ for the use of municipally owned and privately owned water organizations should be appreciated by the superintendent of a water works as well as by his legal counsel.

The **needs** of both New York³¹ and of Boston^{15, 55} for additional water were recognized by the referees appointed by the United States Supreme courts in the disputes with adjacent states. The situation in New York became sufficiently severe during the dry period for emergency measures in curtailing water use to be instituted.

Operation

The performance planned for the **William Hale Thompson pumping station** in Chicago, and the operating results when the plant was put into full service and tested over a period of time, showed surprisingly close agreement.³⁵

Cross connections in the cities of Texas have been greatly reduced in the interest of safeguarding the public health.⁶ Fort Worth has a publicly owned raw-water system carrying a pressure twenty pounds per square inch higher than the potable water supply of the community and it is therefore necessary to safeguard the city supply with great care against any cross connections between the two systems. The Dallas water supply comes from a source having marked **variation in turbidity**. Secondary aluminum sulfate treatment has been employed following the original dosage with iron sulfate and lime, but the results have not been satisfactory on account of the high pH of the water after iron and lime coagulation.⁵⁴

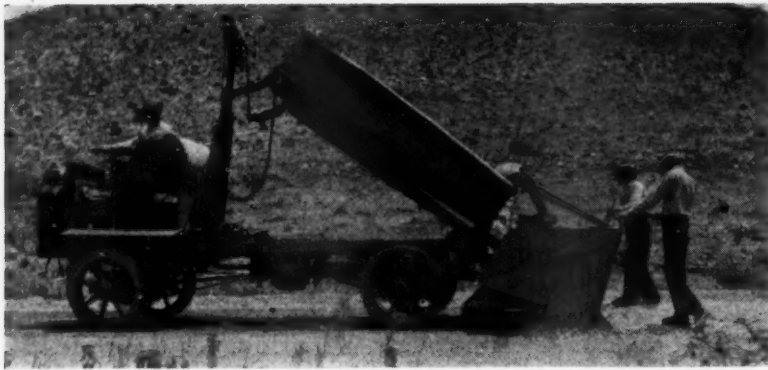
A historical review of the **sedimentation basins** of the United States has been begun by John R. Baylis. Tables of many interesting details about the basins are

given in the first installment.⁷² Consideration of the turbidity, plankton and mineral content of the Detroit city water supply is given in a paper by Bert Hudgins, of the Department of Geology of the College of the City of Detroit.⁴⁵

Chlorine for the treatment of small town water supplies in France is advocated by Chaudoir.⁵² **Superchlorination and dechlorination** studies are reported by Norman J. Howard, of Toronto,³⁹ and by Frank E. Hale, of New York.³⁸ The method has been studied and applied at Toronto for some years. Howard's current report deals with methods of **sulfur dioxide** administration in the dechlorination of the superchlorinated water. Considerable difficulty was experienced in avoiding cooling of the sulfur dioxide and consequent failure to keep up sufficient pressure in the administration apparatus. The sulfur dioxide is obtained in ton cylinders of the same type which is used for chlorine shipments. Doctor Hale used the superchlorination process on the water of a well system which showed medicinal tastes on chlorination. It was not determined what caused the tastes, though it was believed that some phenolic substance brought in with gasoline leakage from a nearby garage, or by decomposing iron bacteria, might have been the cause of trouble. The method of treatment proved effective.

The **ammonia-chlorine, or chloramine process** has been receiving a great deal of attention recently, as have many other matters pertaining to taste and odor prevention. First applied on this continent by Race at Ottawa, Canada, it has been slow to attract attention. Enslow⁷⁰ claims that the pH of the water must receive attention if the method is to be used intelligently. At a pH of 4.4 to 5.5 (that is, in the definitely acid range) the dichloramine, NHC_2H_5 , is almost the only product, while with a high pH of 8.4 or more, the monochloramine, NH_2Cl is the product. At neutrality the two substances exist in about equal proportions. The higher the pH, that is, the more alkaline the water, the more chlorine is necessary for rapid germicidal action. Ruth⁴⁰ in describing the use of ammonia and chlorine in an effort to reduce tastes in the water of Lancaster, Pennsylvania, reports that in April, 1928, they began the use of ammonium carbonate, changing to anhydrous ammonia when they could secure an ammoniating machine in January, 1929. Excellent results against taste-producing substances, including algae, are claimed. Ehrhart⁵⁹ claims that the process has been successful in St. Cloud, Minn., in reducing taste difficulties and also in connection with prechlorination in preventing septic action in sludge deposits in settling basins. The satisfactory use of ammonia and chlorine in the treatment of the water supply of Cleveland, Ohio, is described by Ellms⁴¹ and by Braidech.⁶⁴ In connection with the discussion of Ellms' paper, Joseph Race called attention to the **explosive character of nitrogen trichloride** which may be produced by the action of chlorine on ammonia. When the operation is continuous, Race says that the chance of formation of the explosive compound is exceedingly small, but he mentions that in one plant where chlorine was dissolved in a very dilute ammonia solution intermittently, an explosion shattered the absorption tower. The use of ammonia and chlorine did not prove able to help improve the taste of water at Minneapolis when

(Continued on page 76)



Surface treatment in Cochese County, Arizona.

Bituminous Surface Treatment Methods

A symposium on practices and methods, contributed by County Engineers and Highway Officials in all States

MOULDRIE COUNTY, Illinois, last year treated 200 miles of earth road with E2 and E4 road oil, giving a treated surface 8 to 16 feet wide, at a cost of \$300 per mile. Most of this was done by contract, but some by the townships. *Guy T. Little, County Superintendent of Highways.*

In Cape May County, N. J., 75.45 miles of gravel surface were treated, 20 feet wide, at a cost of \$1200 per mile. This was done by contract. The binders used were S. C. O.-Tar-L.B. The procedure involved reshaping the surface, cleaning with power brooms, patching all holes, rolling until thoroughly consolidated, and applying the treatment. Sand and gravel were used as aggregate.—*Rolland A. Sharpe, County Engineer.*

Eight miles of surface treatment, 24 feet wide, cost Pinal County, Ariz., \$2310 per mile. This was on a clay-sand soil base. The surfacing was pit-run caliche. The equipment used included a Barber-Greene loader, White and Liberty trucks, and a Wehr grader. The material was dumped on the road, and spread by hand and by the grader to the desired thickness and shape. There was no interference with traffic. No preparation of the subgrade was necessary other than to grade it to shape.—*Louis O. Fiscel, County Engineer.*

Fresno County, Calif., last year oiled 2,000 miles of road at a cost of \$250 per mile, using crude oil. The roads were scarified and bladed. The equipment used were oil distributors and power graders.—*Chris P. Jensen, County Surveyor.*

Hot asphalt and Bitumuls were used by Napa County, Calif., in surface-treating 22 miles of road. The surfacing was placed on a crushed rock base, and the aggregate was $\frac{1}{8}$ to $1\frac{1}{2}$ -inch material. The work was done by contract at a cost of \$2,000 to \$4,000 per mile.—*Edw. P. Ball, County Engineer.*



Oil-treated road in Moultrie County, Illinois.

Alameda County, Calif., used emulsified asphalt to surface treat 90 miles of road to an average width of 20 feet. This was old waterbound macadam. Crushed gravel was used for the aggregate, in sizes $\frac{1}{8}$ to $\frac{3}{4}$ -inch. The equipment used included an oil distributor, trucks, power broom and roller. A carpet coat was constructed $\frac{3}{4}$ -inch thick, using two applications each of $\frac{2}{3}$ gallon of emulsified asphalt. The cost averaged \$1,300 per mile.—*George A. Posey, County Surveyor.*

Emulsified asphalt and road oil were used by Siskiyou County, Calif., for surfacing 20.5 miles of old gravel, to a width of 18 feet, at a cost of about \$2,700 per mile. In this work an oil distributor, "60" tractor, gas shovels, rollers, trucks and graders were used.—*A. F. Parrott, County Surveyor.*

Twelve miles of marl, shell and rock roads were surface-treated by Lee County, Fla., with Texaco binder and sand and $\frac{1}{4}$ to $\frac{3}{4}$ -inch rock. The cost for the sand treatment was \$450 and for the rock treatment, \$1,000 per mile of 9 and 16-foot width. The procedure was as follows: The surface was thoroughly swept and two applications of Texaco macadam binder were made, each of $\frac{1}{3}$ gallon, and covered with sand; or $\frac{1}{2}$ gallon of Texaco No. 45 road oil, followed in 10 days with $\frac{1}{2}$ gallon Texaco macadam binder, with 50 pounds of $\frac{1}{4}$ to $\frac{3}{4}$ -inch rock per square yard, and rolled with light roller.—*W. G. Gibson, County Engineer.*

The Twin Falls Highway District, Twin Falls, Idaho, treated three miles of crushed rock with 1.6 gallons of 60-70 road oil and 800 yards per mile of pit-run gravel, mixed in place on the roadway. For this work an oil distributor and four patrol graders rented from the State Highway Department were used.—*S. D. Sinema, Director.*

Twelve miles of old gravel was surface-treated by Allegan County, Mich., at a cost of \$1,800 per mile, using $\frac{1}{2}$ -inch lime stone and tar. Equipment used included an oil distributor, trucks and a roller.—*Glenn B. Cook, Engineer.*

Cut-back and emulsified asphalt were used by Barry County, Mich., in surfacing three miles of old gravel at a cost of \$1,800 to \$2,600 per mile. The surface was 18 feet wide. The gravel aggregate for surfacing was under 1-inch. The procedure was:

(Continued on page 51)

Prime coat of one-third gallon per square yard; mastic course mixed in place to a thickness of $1\frac{1}{2}$ inches, and shaped and rolled. Seal coat of $\frac{1}{4}$ gallon per square yard, using pea gravel or screenings below $\frac{1}{4}$ -inch size. Trucks, tractor, roller and oil distributor were used.—*J. G. Rakowsky, Engineer.*

Van Buren County, Mich., used tar and asphalt, with gravel and limestone, maximum $\frac{3}{4}$ -inch, in surfacing 19.5 miles of 17-foot road, at a cost of \$2,440 per mile.—*H. M. Ward, County Engineer.*

Tarvia with pea gravel and sand, mixed on the road, cost \$1,600 per mile of 22-foot surface, in Winona County, Minn.—*E. P. Effertz, County Highway Engineer.*

The procedure in constructing twelve miles of bituminous surface treatment in Beaverhead County, Montana, was as follows: 8-inch base of crusher run, $\frac{1}{2}$ -inch and smaller; 4-inch top of $\frac{3}{4}$ -inch crusher run. Windrowed after applying oil; cultivate; blade mix; more oil; cultivate; blade mix to proper consistency; lay down; smooth up; traffic compact with blade maintenance. Asphaltic oil, 75-80; crushed gravel. 18-foot width. Cost \$3,500 per mile.—*George R. Metlan, County Engineer.*

Sullivan County, N. Y., treated 127 miles of county roads, 14 feet wide, mostly old macadam, with tar at an average cost per mile of \$540. The equipment used included stone spreaders, power graders, dump trucks, 8-ton gasoline roller and oil distributor. The procedure was: Spreading stone, applying the oil, blading with power graders, rolling, adding more stone to blot up excess oil as needed.—*A. C. Toas-pern, County Highway Superintendent.*

Forty-one miles of tar and asphalt surfacing was placed on Cuyahoga County, Ohio, roads, 16-foot width, at an average cost of \$1,000 per mile. Stone used was $\frac{1}{2}$ -inch. Equipment: Tar or oil distributor and Big Sandy spreader. Method: Surface cleaned; apply $\frac{1}{4}$ gallon bituminous material; 1 ton of $\frac{1}{2}$ -inch stone per 100 square yards; roll.—*Fred R. Williams, County Surveyor.*

Tarvia, CT, HT and MT, were used by Warren County, Ohio, in surface treatment of twelve miles

of old traffic-bound gravel. For an 18-foot width of roadway, the average cost was \$2,300 per mile. Crushed, washed gravel was used for aggregate. A power maintainer did the mixing. Procedure: Sweep clean; prime coat of CT; spread stone about 1-inch; apply MT or HT; mix thoroughly with power maintainer, and keep mixing till ready to set up. Roll.—*P. O. Momfort.*

Jackson County, Okla., treated 8.6 miles of old gravel with asphalt road oil and gravel passing a $\frac{3}{4}$ -inch screen. Cost for 18-foot surfacing was \$825 per mile; the gravel previously placed cost \$3,500 per mile. Most of the work was done by contract. Procedure: Surface gravel, down one year, smoothed and partially loosened with motor patrol; oil placed in three applications; loose gravel rolled from edges into oil and mixed thoroughly. "Have one perfect mile."—*Jno W. Riley, County Engineer.*

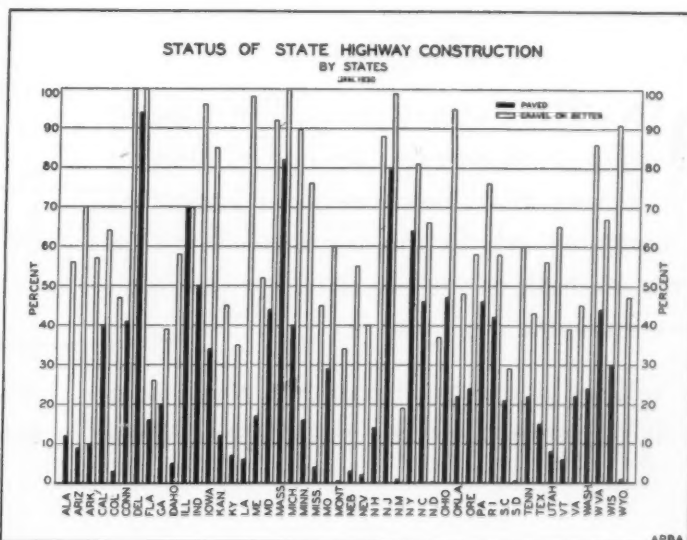
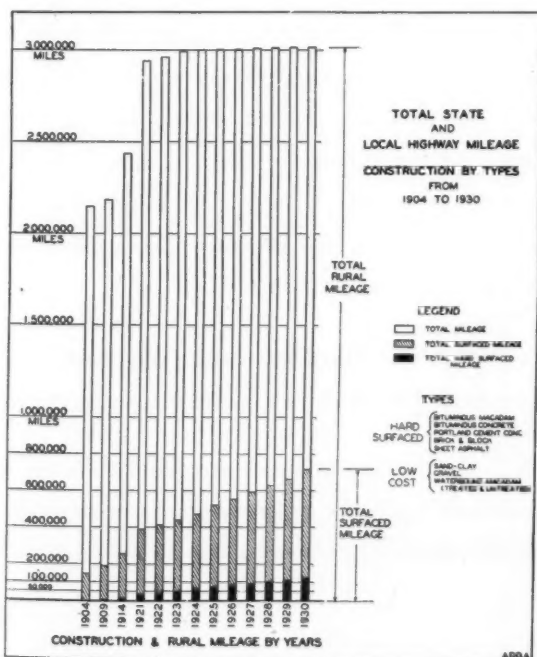
Forty miles of macadam was treated with asphalt and 1-inch crushed gravel, 18-foot width, at a cost of \$600 per mile in Lane County, Ore. Equipment used: spreaders on truck and Etnyre distributor.—*P. M. Morse, County Engineer.*

The methods used on six miles of 20-foot gravel in Polk County, Ore., \$200 to \$500 per mile, were: $\frac{3}{4}$ -inch crushed gravel and 60 road oil; scarify; spread and windrow gravel; oil base, spread gravel; oil and mix; let traffic pack and keep level with maintainer.—*Walter W. Larsen, County Engineer.*

In Wallowa County, Ore., rock was crushed with a Russell portable crusher, hauled by two Mack and four Moreland trucks; road surface trenched with grader before gravel is put on. Blading done by two one-man patrols. Cost for 12-foot surface, \$1,500 per mile. *Glenn Jacob, Water Master.*

One mile of oiled gravel cost Hughes County, S. D., \$1,700 complete. One-inch screened gravel was placed on road, and oil applied. This was harrowed and bladed after each application. Then rolled.—*D. W. Chesley, Highway Superintendent.*

Bitumuls binder and $\frac{1}{4}$ -inch slag were used on $1\frac{1}{2}$ miles of 16-foot roadway in Ohio County, West Va. The cost was \$1,500 per mile. Surface was first swept clean; holes patched; bitumen placed on the road; aggregate scattered; rolled. Oil distributor and rollers only were used.—*C. E. Kindelberger, Engineer.*



Statistics concerning highway construction in the several states compiled by the American Road Builders Association.

Save Money

by using

GELEX

GELEX No. 1 GELEX No. 2 GELEX A

These du Pont dynamites have already reduced blasting costs in mining iron, lead, zinc, molybdenum, limestone, gypsum and clay in quarrying limestone, granite and trap rock in excavating for railroad and bridge construction and in driving railroad and sewer tunnels

• •

DYNAMITES of the Gelex type are designed expressly to decrease the cost of blasting in work that has been done heretofore with ammonia gelatin ranging from 35 to 60 per cent strength or with 40 or 60 per cent high density ammonia dynamite.

They will *not* give as good results as these older explosives in *every* operation—much depends upon

local conditions—but *Gelex has lowered costs in many operations.*

Gelex No. 1 and Gelex No. 2 stand between low density ammonia dynamite and gelatin dynamite—more cohesive and much more water resisting than ammonia dynamite but bulkier than gelatin. Gelex No. 1 averages 105 cartridges, 1¼ by 8 inches, to the 50-pound case; Gelex No. 2 averages 120 cartridges. No. 1 has a bulk, or cartridge, strength of 60 per cent; No. 2 of 45 per cent. Both are adapted for underground as well as open work.

Gelex No. 1 has thus far found its chief usefulness in well-drill holes in limestone quarries.

Gelex No. 2 has been most successful as top load in well-drill holes in quarrying; as entire load in well-drill holes for excavating shale; in smaller



diameter holes in bench or low face limestone and gypsum quarries; and in limestone, gypsum, clay, lead, zinc and iron mines.

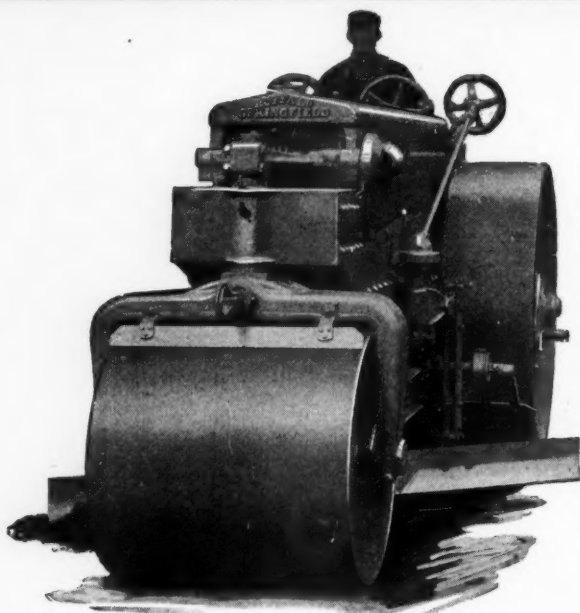
Gelex A has much the same characteristics as 60 per cent ammonia gelatin but is of slightly lower velocity and lower density, averaging 99 cartridges, $1\frac{1}{4}$ by 8 inches, to the 50-pound case. It is plastic and water resisting and gives off a relatively small volume of harmful fumes. Gelex A has proved an efficient substitute for 60 per cent ammonia gelatin for blasting limestone,

granite and trap rock in quarrying and in excavating for construction work; for driving tunnels in sandstone and limestone; and for mining iron ore. At present this explosive is offered for sale only east of the Rocky Mountains.

If you think Gelex is adapted to your mining, quarrying or contracting requirements, tell us the conditions. Our extensive experiences may enable us to apply Gelex as a means to solve your problems.



E. I. DU PONT DE NEMOURS & CO., Inc. Explosives Dept. Wilmington, Delaware



LEADERSHIP

Ability to lead means having those qualities that men recognize as superior. **Nothing else** makes leadership.

From coast to coast, wherever new roads are being made or present ones repaired, Buffalo-Springfield Road Rollers are the choice of the men on the job. Advanced design and superior performance make these rollers widely accepted as leaders worthy of the name.

Various steam and motor-driven designs in all practical sizes. Attachments when desired. Interesting booklet on request.

The
Buffalo-Springfield
Roller Co.
Springfield, Ohio

BUFFALO—
SPRINGFIELD
ROAD
ROLLERS

When writing, please mention PUBLIC WORKS

How Will the Volume of County Work in 1931 Compare With 1930?

IF THE figures furnished to PUBLIC WORKS by the engineers or other highway officials of about 550 counties scattered through almost all the states can be taken as a basis, the county highway funds (not including federal, state or township) which will be spent this year will be about 8 or 9 percent less than in 1930. As prices of most materials and wages have fallen by an amount averaging at least this percentage, it is probable that about the same amount of road work will be done by county funds this year as last.

Dividing the county into geographical districts (using the Federal system, as heretofore), we find that conditions do not vary greatly in the different districts. So few counties in the New England states do any work that the figures from those few, which indicate an increase of 13 percent, may not have much significance.

One other district, which is well represented in our reports, shows an increase in expenditures—the West South Central, averaging 4.3 percent increase. Arkansas and Oklahoma report a slight decrease, which is more than made up by the increase in Louisiana and Texas.

The other districts report decreases ranging from 1.4 percent in the Middle Atlantic to 19.6 percent in the South Atlantic. In the former we find New York in the plus column, and in the latter Virginia and Georgia.

The East North Central and East South Central each reports about 9 percent decrease, with Illinois only in the plus column.

The West North Central reports a decrease of 11.6 percent, with Missouri alone in the plus column. The Mountain section reports 13.8 percent decrease, with Idaho and Nevada in the plus column. All three of the Pacific states report a decrease, averaging 8.2 percent.

Considering individual counties, we find that 26.8 percent reported increased expenditure, 55.9 percent decreased expenditure, and 17.3 percent the same as last year.

No district is without some counties that report increased expenditures. In the Middle Atlantic district, 38 percent so reported; 8 percent in the South Atlantic; 32 percent in the East North Central; 7 percent in the East South Central; 24 percent in the West North Central; 37 percent in the West South Central; 35 percent in the Mountain; and 32 percent in the Pacific district.

Only nine of the states did not contain any counties which reported increases—three in the South Atlantic, three in the East South Central and three in the Mountain district.

In some cases there were special reasons for decreased appropriations. For example, in North Carolina the state takes over the county highways in July, and probably most of the county appropriations were for the first half year only.

Altogether, taking into account the somewhat lower cost of work this year and the extra anti-unemployment appropriations of the federal and several state governments, the prospects appear favorable for as much highway work this year as last, and probably more.

RECENT LEGAL DECISIONS

By John Simpson

HIGHWAY CONTRACTS

Contract Provision for Payment of Materialmen from Retained Fund

A highway contract provided that the board of commissioners should pay for unpaid labor or material out of the proceeds of the bonds issued or other funds due or receivable by the contractor under the contract or bond. The Indiana Appellate Court holds, *City Nat. Bank v. Board of Comrs. of De Kalb County*, 172 N. E. 201, that this provision was a valid contractual stipulation, for the benefit of unpaid labor and material claimants, whether they had complied with the provisions of the statute or not. Such provisions in the contract gave to them, and to the surety, if needed, a remedy in addition to that given by the statute; and they were entitled to a 20 per cent retained fund in preference to an assignee of the contractor. The assignee, a bank which had received warrants due to the contractor which it had paid to his checking account, instead of applying them to the discharge of a loan to the contractor, was held to have waived its right, if any, to the assignment of the funds as a collateral security as against the rights of the labor and material claimants to the fund.

Exhaustion of Highway Construction Appropriations

The Connecticut Supreme Court holds, *Silliman & Godfrey Co. v. Town of Westport*, 150 Atl. 502, that a contractor for the construction of so much of a highway as could be constructed with appropriations then made by the municipality was not required to ascertain the total amount available from the appropriations and check the expenditures to see when the money was exhausted; and the town was effectually estopped, not having notified the contractor of the exhaustion of the appropriation, as it was bound to do, from denying liability for the amount of withheld percentages of the progress payments.

Contracts by County Commissioners in Excess of Current Annual Estimates Forbidden

The Oklahoma Supreme Court holds, *Boardman Co. v. Board of Comrs. of Ellis County*, 276 Pac. 474, that a law forbidding county commissioners to make any contracts or approve any liability in excess of the estimate of the excise board for the current year must be strictly enforced, and under such a statute, C. O. S. 1921, §10102, county commissioners cannot enter into contracts for the reconstruction of county bridges destroyed by flood waters and to be paid for out of taxes to be assessed, levied and collected for a succeeding fiscal year without the assent of three-fifths of the voters of the county, as provided by the state Constitution.

Shrinkage Factor in Measuring Excavation Work

A contractor undertook the construction of an embankment for a section of a state highway under a contract providing that the compensation therefor was to be computed on the size of the borrow-pits from which material was excavated. After the fill was made the highway was submerged by flood waters which par-

tially filled the borrow-pits and their original areas could not be satisfactorily measured. In an action by the contractor for services performed, the California Supreme Court held, *Atkinson v. State*, 206 Cal. 617.275 Pac. 412, that it was apparent that the use by the trial court of a 21.1 per cent shrinkage factor did not furnish a satisfactory basis of compensation to the contractor, where the evidence showed that the shrinkage factor with reference to the borrow-pits not disturbed by the flood was considerably greater, and, in one instance, was 52.9 per cent.

Earthen shoulders were constructed wider than called for in the contract and at a different angle, adding much greater yardage of earth to the embankment than was provided for in the contract. Whether the resident engineer, who was alleged to have ordered the extra material furnished, did in fact do so, and if he did so, if he was expressly authorized to do so, were issues for the trial court and its determination that it was not ordered was held binding upon the appellate court.

Compliance With Contract for Gravel

In an action for the price of gravel furnished by the plaintiff to highway contractors, where it appeared that the plaintiff was merely directed to ship one or more cars of gravel, that the highway specifications provided for different kinds of gravel for different kinds of concrete work, that the gravel furnished met some one of these specifications and that the defendants actually took charge of the gravel before the highway agent had an opportunity to pass on the samples furnished, and thereafter used the gravel in the prosecution of the work, the Kentucky Court of Appeals held, *Southerland Bros. v. Huntington Gravel & Supply Co.*, 22 S. W. (2d) 614, that there was no failure on the part of the plaintiff to comply with its contract, but that the loss, if any, was due solely to the defendants' failure to specify in the orders the particular kind of gravel desired, so that the trial court did not err in directing a verdict for the plaintiff.

Claim of Surety Paying Materialmen Against Contractor

A highway contractor who has paid a consideration for his surety bond is entitled to all the protection which the bond provides. Where one of the provisions is the payment of all claims unpaid by the contractor at the time of his default, the surety to carry out fully its contract with the contractor, must pay these claims, and upon payment it has one claim against the contractor and not many claims as the case may be. In *re Hanson-Pearce Const. Co.*, 43 Fed. (2d) 381.

Damages for Trespass in Widening Road

After proceedings were begun to condemn a portion of an owner's land required to widen a road, the contractors began work and subsequently the proceedings were abandoned. The owners then sued the contractors for trespass to their property. The county intervened, alleging that any damages recovered from the contractors would have to be borne by the county,

which was obliged to furnish the right of way for the road. The Kentucky Court of Appeals held, *Reed v. Gorham & Co.*, 25 S. W. (2d) 377, that it was proper to permit the county to intervene, and also to give instructions to the jury upon the theory that the proceeding was one instituted by the county for condemnation of the land.

HIGHWAY MACHINERY

Suspension of Rent of Steam Shovel During Winter

Where a written contract for the hire of a steam shovel, which was not required to be in writing and hence could be modified by subsequent parol agreement, was modified by the parties as to cessation of rent while road work was suspended, the Kentucky Court of Appeals, *Vandivier v. Tye*, 21 S. W. (2d) 1006, held that the fact that after the modification of the contract the lessees unloaded the shovel and took care of it during the winter, relieving the lessor of that trouble and expense, was a sufficient consideration for the modification.

Payment for Tractor From Highway Fund

Under a state statute providing a highway fund for the construction and maintenance of roads in the county, the Arkansas Supreme Court holds, *Anderson v. American State Bank*, 11 S. W. (2d) 444, that such fund is available for the purchase of machinery necessary in the construction and maintenance of roads in the county, such as a tractor. A contract by the county court for such tractor, not being payable out of county funds, but from state funds, was held not void because it exceeded the revenue for the current year. The county court, it was held, would have had a right to make this contract if it required all of this fund to make the first payment, and to provide for the deferred payments to be made in the following years out of this fund. The seller, of course, would take the chance of getting it out of this fund, the risk of whether there would be any fund on hand to pay it.

Warranty of Grading Implement

In an action for the price of a road grader the defense was breach of warranty, stating, in substance, that the machine was not constructed of good first-class material; that it would not do the work it was intended to do as warranted; that its parts continually became broken and could not be made to operate, and that it was entirely worthless on account of faulty construction and material. The North Dakota Supreme Court held, *Citizens' Bank v. Crane Creek Tp.*, 231 N. W. 281, that it was incumbent on the defendant to prove that the machine was worthless for the purpose for which it was intended and purchased.

Implied Warranty of Fitness of Road-Finishing Machine

Where the buyer of a road-finishing machine did not designate the machine required, but informed the seller of its need and left it to the seller's judgment to select a machine which would do the work, the Michigan Supreme Court holds, *Dunn Road Machinery Co. v. Charlevoix Abstract & Engineering Co.*, 247 Mich. 398, 225 N. W. 592, that there was an implied warranty of fitness, both under the common law rule and the Uniform Sales Act, which was not affected by the fact that the contract contained an express warranty of material and workmanship.

Operation of Tractors in Road Work as Within Fuel Tax Exemption

The California Supreme Court, *Oswald v. Johnson*, 291 Pac. 579, holds that rollers and tractors used in the construction or repair of a highway closed to the public are not being "operated upon" a public highway, and therefore are within the gasoline tax exemption of Cal. St. 1925, p. 660, §4, amending St. 1923, p. 575 §11, which authorizes the refund of a license tax for any motor vehicle fuel for purposes other than in motor vehicles operated or intended to be operated upon the public highways of the state.

In *Allen v. Jones*, 47 S. D. 603, 201 N. W. 353, it was held that a traction engine while in use in the construction of a highway is not "operated upon a highway" as contemplated by a similar exemption in the South Dakota Gasoline License Tax Act. In that case, however, it was observed that motor fuel used in propelling tractors or trucks in the transportation of road building material or motor fuel to or from the site of construction is used in "operation upon" the highways and is not purchased subject to the refund.

BONDS PROTECT MATERIAL MEN

Statutes Requiring Contractor's Bond to Protect Materialmen Constitutional

The Ohio Supreme Court holds, *Royal Indemnity Co. v. State*, 120 Ohio St. 378, 166 N. E. 361, that it is within the power of the Legislature to enact that at the time of the letting of a contract for construction of a public building the state or any political subdivision of the state shall require the contractor to give a bond with sufficient sureties conditioned not only for the proper performance of the work, but also that the contractor will pay all persons such sums as may be due them for labor and materials furnished for or used in the construction for which such contract was made. The action was by a materialman for the value of materials furnished to a subcontractor under a construction contractor having a contract with the state for remodeling a building for a state hospital. The principal contractor had paid the subcontractor the full amount due to him under the subcontract, and the subcontractor had become insolvent without paying the materialman. The suit was against the contractor's surety. Holding that the statute was constitutional, the court said: "Similar provisions are found in the statutes of other states of the Union, and so far as we are able to discover, have been uniformly upheld." Judgment for the materialman was affirmed.

Delivery of Materials Authorizing Recovery on Public Works Bond

The New Jersey Supreme Court holds, *Core Joint Concrete Pipe Co. v. Standard Acc. Ins. Co.*, 151 Atl. 470, that where, in an action by a materialman on a sewer contractor's bond, the evidence showed that the materials were duly delivered at the site of the construction to a proper person in charge of the work, and as the construction could not have progressed without these materials, the presumption was that they were used for the purpose for which they were delivered, authorizing recovery on a bond given under a statute to protect those furnishing labor or materials for the construction of public works.

The Practical Operation of Sewage Disposal Plant Units*

THE first duty of the operator is to find out "what it is all about." Unless the operator understands thoroughly what each unit is expected to accomplish, he can not work intelligently and good results will be obtained only by chance. This is particularly important at the start, because failure to observe it may lead to a serious amount of useless labor; to the overlooking of many defects in the design and construction of the plant which could easily be corrected by the operator, to his own benefit and that of the performance of the units; and, what is perhaps most important, to the failure to observe that some units are not working properly, which means an undue or excessive duty upon the units which are to follow. Every machine is most efficient when each member performs its function in the manner it should.

Pumps

The chief duty is to protect against breakage by the maintenance of a proper screen to exclude objects dangerous to the pump, and to provide easy access for opening and cleaning the pumps in case of stoppage. Aside from these, ordinary care and lubrication suffice.

Screens

Unless intelligently cared for, the coarse screen often constitutes a nuisance, due to septic deposits in the screen pit or to the accumulation of foul screenings, which in turn may be due to the clogging of the screen which lessens the velocity of flow. Septic action in the screen pit can be materially lessened by proper design of a self-cleansing invert and the avoidance of dead corners. Dead corners can frequently be eliminated by the operator by filling in with concrete.

Screenings must be removed faithfully and regularly, either by means of some mechanical appliance or by hand, disposed of in a cleanly and sanitary manner, by burying, composting, or incineration. The screenings should not contain an appreciable quantity of feces or other materials better taken care of and digested in the tanks. On screens cleaned by hand, it is often desirable to wash the screenings up and down with the rake, thus allowing feces and finely divided substances to be broken up and pass on into the tanks to be digested there, leaving as screenings only those matters of a coarser and more stable nature.

The purpose of fine screens is to remove all of the suspended solids possible. Mechanical equipment handles the matter removed. The necessary mechanical and cleanly care of such an installation is apparent.

Tanks

Sewage tanks are of various kinds and serve several more or less dissimilar purposes, and the purpose of each tank must be recognized and borne in mind.

The septic tank requires little attention except cleaning out at intervals. Much work and offensive odors will be avoided if the tanks are operated so as to allow a tank, when filled, to be cut out of service to permit the sludge to digest fully for from three to six months, during which time the scum should be

broken up several times to hasten digestion. When the tank is to be emptied to go into service again, the contents should be thoroughly plunged up to enable the sludge to go out upon the sludge bed with the water, so as to avoid the necessity of cleaning out solids after the water has run away.

Settling Tanks

The solids are removed from settling tanks before septic action begins, and either such tanks must be cut out at intervals for digestion or the sludge transferred to a separate digestion tank. Undigested settling tank sludge, if run on to sludge beds, will dry very slowly and quite likely cause serious nuisance.

Modern settling tanks equipped with a mechanical drag, such as the Dorr or Link Belt, are becoming very popular and have certain definite advantages in some cases. In such tanks the flights are operated continuously or at frequent intervals so as to remove the deposited solids as fast as they settle.

Imhoff Tanks

The operation of Imhoff tanks is very simple when the right conditions prevail, it being only necessary to cut tanks in or out as needed, to reverse the flow occasionally to equalize the deposition of the solids, and to draw out sludge at intervals to make room for more solids.

But very often conditions are not right. Thick scum appears on the gas vents, which has to be broken up to make it settle back into the digesting compartment. And what is more troublesome, the tank begins to foam over at a great rate. There are many different opinions concerning the cure of foaming in Imhoff tanks. In many cases an acid digestion appears to be associated with foaming, and an application of lime thoroughly mixed with the sludge, raising the pH to an alkaline reaction, has frequently proved very effective.

Sludge must be drawn at intervals to make room for fresh solids, but if too much is drawn at a time, too little ripe sludge will be left to balance the fresh incoming solids. It sometimes seems necessary to draw out all sludge in the fall in order to provide storage space for the winter when the sludge beds cannot be used; but such practice should be avoided when possible. Glass-covered sludge beds are very helpful in inclement weather.

Separate Digestion Tanks

The operation of these tanks consists in preserving a proper balance of ripe sludge to fresh solids, of maintenance of temperature in artificially heated tanks, drawing off the supernatant water, and the sludge as digested.

Sludge Beds

Unfortunately the weakest, puniest, and most undersized member of the sewage plant is too often the sludge bed.

Sludge beds should be of ample size, of ample depth, of proper material and well underdrained. If too small, the dose of sludge will be too thick and slow drying. If the bed is thin, the sludge will invariably work down into the underdrains, which will

*Abstract of address presented before the Short Course for Plant Operators at Rutgers University, New Brunswick, N. J., March 13, 1931, by Major Francis E. Daniels, Pennsylvania Dept. of Health.

FAIRBANKS VALVES

Easy to Operate



THE double taper wedges of these Bell End Gate Valves are so guided that they cannot scrape against the valve seats.

They align themselves to any slight change in angle due to pipe strains and cannot get out of order unless from abuse. At all times, they are easy to operate.

These valves are made in accordance with the American Water Works Association Specifications.

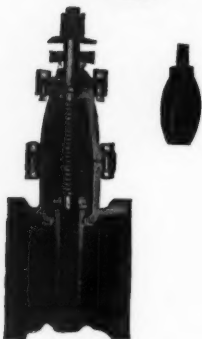
VALVES FOR EVERY SERVICE

Write for Complete Catalog No. 20.

The FAIRBANKS Company
BOSTON NEW YORK PITTSBURGH

Factory: Binghamton, N. Y.

Distributors Everywhere



RECOMMENDED
and approved by
many nationally
prominent Sanitary
Engineers. Plans and
Specifications submitted
promptly on request.

Hitchings Company
ELIZABETH
NEW JERSEY

When writing, please mention PUBLIC WORKS

necessitate digging up the drains and rebuilding the bed. And if insufficiently underdrained, the bed will be sluggish and clog.

The bed must be preserved in good condition by keeping it in a deep, porous condition, with fine material (sand or fine cinders) on top to prevent the sludge from working down into the bed. It must be thoroughly cleaned after each use; a fresh dose should never be run onto old sludge on the bed. You want rapidly drainable sludge, but you may not always be able to get it. Poor sludge may be materially improved by the application of a solution of alum or ferric chloride to the dose as it is drawn from the tank. This coagulates the colloidal suspensions in the sludge, causing them to release the water.

When you are to draw sludge, be sure to have your bed in good condition and know what kind of sludge you have to draw. Do not put on the bed any more than will dry in a reasonable time, or you will have, much to your sorrow, your bed tied up under a sludge pond forever and a day. Several thin doses can be dried and removed from a bed in the time it takes to dry down a dose which was too thick to drain properly. It frequently happens that a bed is needed urgently when a dose is not draining properly, which necessitates handling only partially dried sludge. This is very costly and often a nuisance-producing process.

In the use of glass covered sludge beds, pay particular attention to ventilation. Water does not evaporate from a stoppered bottle.

The following table shows the reduction in amount of sludge to be handled by the elimination of only a few percent of water. Therefore, the driest sludge in the least time is our aim.

%	Amt.	%	Amt.	%	Amt.
Water	Sludge	Water	Sludge	Water	Sludge
0	1.00	50	2.00	96	25.00
1	1.01	60	2.50	97	33.33
2	1.02	70	3.30	97.5	40.00
5	1.05	75	4.00	98	50.00
10	1.11	80	5.00	99	100.00
20	1.25	85	6.66	99.1	111.00
30	1.43	90	10.00	99.4	166.00
40	1.66	95	20.00	99.5	200.00

Dosing Apparatus

The care of butterfly valves or mechanical distributors for dosing large filters is evident. Such devices as the air-locked siphon or the more complicated air-locked sewage feed and discharge apparatus are not so simple but should be understood thoroughly. The alternating, rotating, timed and twin apparatus are quite interesting and ingenious. There are at present only a few styles of siphons and feeds on the market.

Trickling Filters

The action of the trickling filter is practically continuous, and there is no necessity for the long intervals of time between doses frequently noticed. The maximum rate should not be exceeded. This may vary somewhat according to the character of the sewage and depth of bed, but about two million gallons per acre per day is the usual good practice.

Uniform distribution over the filter is necessary, and is accomplished by proper design and care of the dosing apparatus and nozzles. If the distribution is not uniform, parts of the bed are not working and other parts may be seriously overworked. A partially clogged nozzle or a small leak in a pipe will show bad effects at the underdrains.

Occasionally the growths of oscillaria, (a blue-green alga) frequently seen on trickling filters may

(Continued on page 70)

Sewage Treatment Plant at Freeport

(Continued from page 22)

and the efficiency of the drying beds is watched very carefully by sampling the sludge daily and noting the daily loss of moisture. The moisture and organic and mineral content are determined with each run off of sludge. We have experimented quite some as to how much the top ventilators and side windows of the glass enclosures should be left open or closed. Our experience has proven to us that in the summer months the top ventilators must be open at least six inches and side windows from two to three inches to stop sweating. In the winter months only the top ventilators are left open for about one inch. No sweating has been noted.

The temperatures of the settling tanks and digestion tanks are taken daily; also the outside temperatures. Wind directions are noted daily.

A very complete daily log sheet is in use, and all the necessary data concerning the operation of the plant are kept. Not only is this of great value for the present, but also in the future, when the time arrives for extensions, all the necessary data will be available.

A Yarnall Waring V-notch weir recording meter is located in the head house and works from the float chamber, which also governs the chlorine machine. This enables us to keep an accurate record of the sewage flow.

Sludge is pumped three times a week at the present time. This will be increased to daily pumping just as soon as the sewers under construction are completed.

Sedimentation tanks are skimmed four times a week and all floating material broken up by hosing. Material in suspension, after hosing, is skimmed off and removed to the digestion tanks.

All four digestion tanks are well seeded and show a p.H. of from 7.0 to 7.4. Tests are made on the sludge by the filter method. The tanks are so arranged that the sludge is worked from No. 1 tank through to No. 4 tank and run from No. 4 to the drying beds. At no time are the tanks emptied. As raw sludge is added, semi-digested sludge is run into the other tanks.

Data of Sewerage Treatment Plant

Type of sewage	Fresh, domestic
Industrial water	None
Total flow of year	114,219,200 gallons
Average daily flow	500,000
Total yearly screenings	317 cu. ft.
Total dry sludge removed from beds	58 cu. yds.
Population served	2,500 persons
Total pounds of chlorine used	2,958
Pounds of chlorine per million gallons	47.78
K.W. per million gallons	69.35
Total cost per million gallons	\$12.50
includes chlorine, power, supervision, maintenance, insurance, etc.	

Laboratory Determinations

Average residual chlorine (orthotolidin test)	0.4
percentage solids removed (Imhoff cone, 2 hr. setting)	97.3%
p. H. of influent	6.4
p. H. of effluent	6.8
p. H. of digestion tanks	7.1
percentage of moisture in wet sludge	86.4
percentage of organic matter in wet sludge	13.6
temperature of influent	43°
" effluent	47°
" digestion tanks—summer	73°
" " " winter	42°
Relative stability of tank effluent	48%

No trouble has been encountered except some gasification of the sedimentation tanks. This has been overcome by the more frequent pumping of the sludge; also the finding of a paint that would last on the inside of the tank covers and on the pipes immersed in the tanks. After trying many formulas, Inertol was tried and up to this time it has proved very successful. The iron work in the drying beds is now painted with aluminum paint.

Fortunately, from the inception of the sewage treatment works the officials have taken a keen interest in our work. They have cooperated in every way possible.

On various occasions we have had delegations of the business men's and civic associations as our guests. This has been a great help to break down the average impression that John Taxpayer has concerning sewage works and it has made people realize that after all there is something more to a treatment plant than an inlet and outlet pipe.

I would like to say a word to Mr. Designing and Consulting Engineer. Please don't desert the poor plant operator when the construction is completed. His troubles are just beginning and he needs you like a babe needs its mother.

I firmly believe that it should be a part of the designing engineer's contract to supervise the operation of the plant for at least one year after completion. Oftentimes a worth-while plant is ruined by the operator, who is usually unfamiliar with plant operation.

Construction of a Low-cost Pavement in Grass Valley, Calif.

(Continued from page 20)

foot wide roadway per day, allowing for time spent in improving drainage structures, gutters, sidewalks, etc. While this is not a rapid rate of construction, it gave a well approved type of street that will give an indefinite service with a very low maintenance cost, and the city already possesses the necessary equipment to take care of the subsequent maintenance work. By a continuous construction program, the pavement may be extended to such streets as show need for the higher type of surface, which will undoubtedly include practically all but some of the roads in the undeveloped sections of the town.

The most important construction features of this type of work are:

1. Careful preparation of subgrade to proper profile.
2. Use of clean, hard crushed rock.
3. Thorough compaction with approved type of roller.
4. Satisfactory application of asphalt by proper type of asphalt heater and sprayer.
5. Complete covering of asphalt coatings.
6. Final compaction by further rolling.

Although detailed costs of all phases of this work have been kept by Mr. Bennetts, and can be obtained from him or the city clerk, the average figure is close to 4c per square foot of pavement completed. This figure agrees almost exactly with construction costs on similar work, which was done with almost identical equipment, by the City of Auburn, California, in 1929, when about 4.5 miles of this type of street was laid.

The work described in the foregoing article is ac-

CEMENT LINED SERVICE PIPE

Guaranteed Against Injury From Handling. Standard Fittings With Special Shaped Lining That Makes Perfect Joints.

**CEMENT LINED PIPE COMPANY
LYNN, MASS.**

DAYTON-DOWD CENTRIFUGAL PUMPS

FOR

Waterworks and Filtration Plants
Sewage Disposal Plants
Sewage Relift Stations

Designed and built by Centrifugal pump specialists of long experience

MANUFACTURED BY

DAYTON-DOWD COMPANY, Inc.

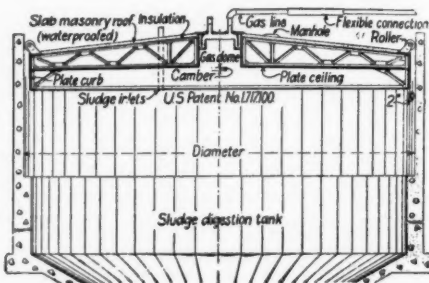
WORKS—QUINCY, ILLINOIS

SALES OFFICES IN 51 CITIES

DOWNES Floating Covers

for

Separate Sludge Digestion Tanks



PROVIDE for variation in sludge content which flexibility does not exist under fixed types of concrete roofs.

They reduce initial and daily operating costs as well.

Write for Bulletins 104 and 104-A

Pacific Flush-Tank Company

136 Liberty St.
New York, N. Y.

4241 Ravenswood Ave.
Chicago, Ill.

When writing, please mention PUBLIC WORKS

completing a very great improvement in the streets of Grass Valley and is an outstanding example of what can be done with a small crew and at a very reasonable cost to the people. Of course, the comparatively small amount of machinery needed must be of first class design, modern in every way, and fully adapted for the work, and the company selling the equipment must stand ready to give instant service with parts or replacements, as delays are costly.

The superintendent must, of course, organize his work to somewhat close limits with a crew of this size, in order properly to follow out the sequence of the work. Many phases of the construction will be influenced by weather conditions and by materials, and the man in charge must watch and study these matters constantly, that the results may be uniform. There are practically no complicated details of engineering in this type of pavement, and excellent results are obtained with almost inexperienced men, who rapidly learn the many "kinks" of such construction.

Rapid Installation of San Francisco's Emergency Water Supply

(Continued from page 23)

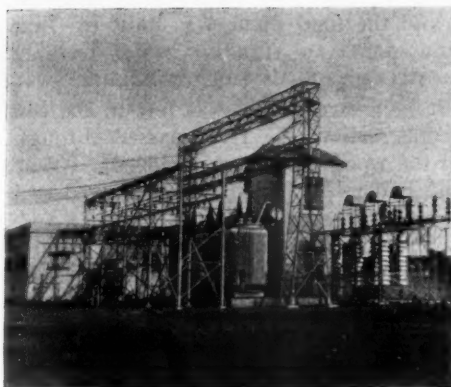
namely: The East Bay Municipal Utility District officials, the Western Pipe and Steel Company, Byron Jackson Pump Company, General Electric Company, Pacific Gas and Electric Company, Enterprise Foundry Company, the several departments of the city of San Francisco and the personnel of the engineering division of the water department, under the direction of M. M. O'Shaughnessy, city engineer, and N. A. Eckart, general manager of the water department. T. W. Espy, engineer of water production, was in active charge of the entire project. The design and office engineering were under direction of J. E. Flaa, hydraulic engineer. W. C. Renshaw was field engineer in charge of construction. J. J. Phillips, chief right-of-way agent, and his assistants, cooperating with Dion Holm, attorney for the water department, obtained the right of way.

Drain Laid on Soft Soil

Winchester, Mass., has for some years been using a low, swampy area just outside the business district as a dump for ashes and clean rubbish. It had become an eyesore, and extensive highway work near by afforded the opportunity of covering it with earth. As a stream ran through the site, a culvert or drain 140 feet long was necessary, the diameter of which was calculated to be 36 inches. It did not seem desirable to lay a concrete or vitrified clay drain on this soil without driving piles to support it, and firm bottom was 50 to 60 feet below the surface. Previous experience of the town engineer, James Hinds, with corrugated iron pipe, supplemented with investigations by Parker Holbrook, the superintendent of streets, led to the decision to use this material, as apparently a slight settlement would not rupture it.

Heavy gauge Armco paved-invert pipe in 12-foot lengths was used, with a 45° angle about mid-length of it. Short cross sills of wood were placed in the shallow excavation and the pipes rolled on to them and fastened together by means of corrugated connecting bands. Backfilling was begun at once and carried to a depth of 6 or 8 feet above the pipe.

It is expected to use this area as a park and playground when it has been filled in.



At left—Control house and transformers of the substation at Santa Mesa where the current from Botocan passes before it enters Manila

At right—A view of the dam showing bridge after completion. All hand rails and lighting fixtures have been installed

Below—Interior of the power house after completion. The two 7,500 kw. generators in the foreground



Romance of Engineering in the Philippines

(Continued from Page 32)

of concrete material daily from Pagsanjan to Botocan.

Even before the Luisiana-Botocan road was passable for trucks, men carried materials up the mountainside and a construction camp began to rise on the banks of the Botocan river. The camp included an engineering building, mess hall and dormitories, quarters for

nurses and doctors, a hospital, camp store, houses for some of the engineers, and sheds for equipment. A sewerage system was also built.

Water supply was difficult at first, but a spring of potable water was finally discovered, was piped to the camp, and pumped into a large overhead storage tank. By December, 1929, oil engines were supplying electric lights. The camp was so carefully guarded against disease that there was very little sickness.

Site of the dam is 1,900 feet above the falls. The dam itself is of the overflow gravity type. It is of solid concrete, 67½ feet wide at base and 108 feet high to the floor of the bridge. It is 230 feet long at its upstream side and backs up a small lake which in time of low water is drawn down 20 feet. Storage capacity of this reservoir is 10,400,000 cubic feet. The dam has four heavy steel Taintor flood gates, each 25 feet wide by 10 feet high, which can be raised to allow flood waters to pass.

Actual construction of the dam was preceded by the erection on the site of a storehouse, shop building, power plant for construction, and garage for 15 cars.

Construction of the dam was the greatest and most difficult

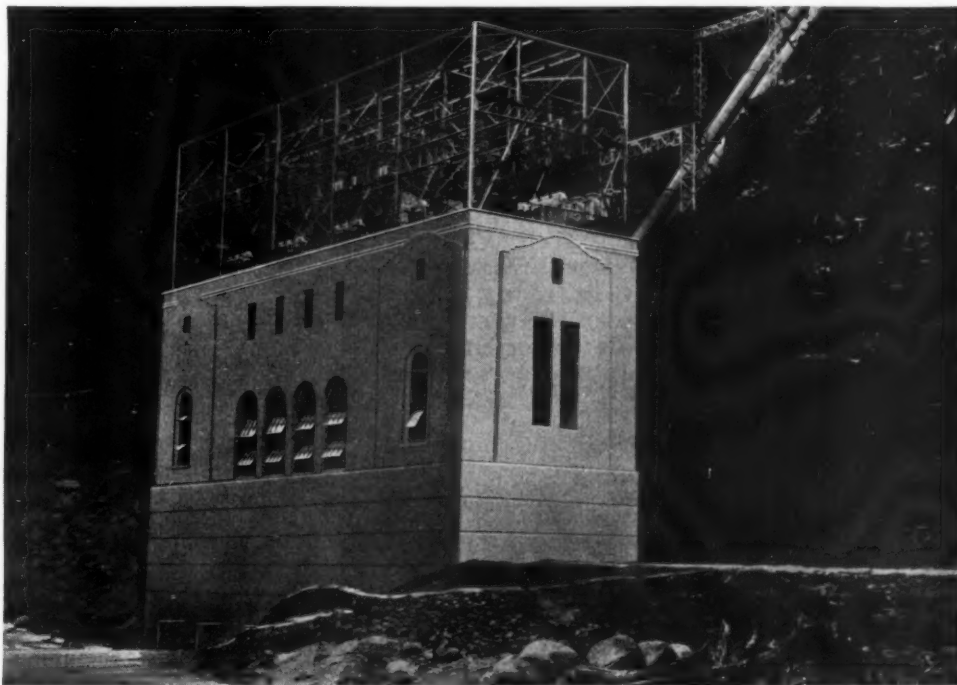


part of the whole project. The Botocan watershed of 25 square miles sent raging torrents down the Botocan river. Fury of typhoons added to the difficulties. Flood upon flood carried away materials as fast as they were put in. Difficulty was met with in excavation also. Blasting down for a foundation, it was not until a depth of 30 feet below the river bed was reached that the engineers considered the formation of basalt boulders embedded in

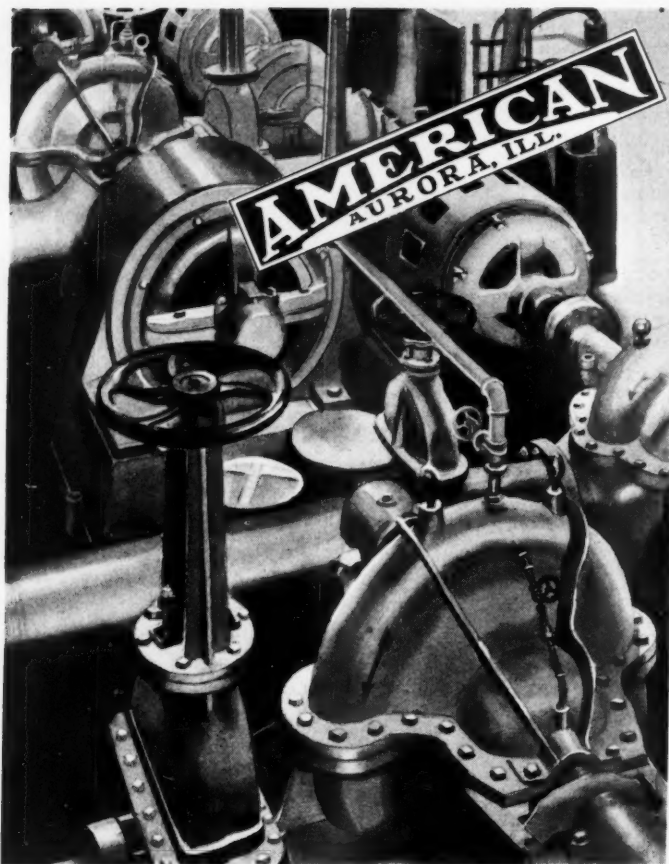
volcanic clay they encountered of sufficient bearing capacity to support the dam.

The dam was built in five sections and it was not difficult to build the first two sections because this was done in the dry season, but when the remaining three sections were to be poured, it seemed impossible to build cofferdams and flumes to withstand the force of sudden torrents brought down by an unusually early rainy season.

Construction became a continuous cycle of flood-outs, pumping and foundation pouring. The second downstream cofferdam was carried away the night it



New power house in the gorge



Three fifteen-inch double suction "American" Centrifugal Pumps installed in Grosse Point, Highland Park, Detroit, Michigan

"AMERICAN" PUMPS for Detroit Water Service

ILLUSTRATED are some of the "American" Centrifugal Pumps that supply part of the millions of gallons of water to the City of Detroit.

The serious questions of fire protection, sewage disposal and ample water supply are PUMPING problems. "American" pumping equipment has been developed over a long period of years to meet the unusually rigorous requirements of the modern municipality.

Centrifugal Pumps, Sewage Pumps, Deep Well Turbines and Deep Well Plunger Pumps bearing the "American" trademark are standard equipment in many cities and villages. The advice of "American" engineers with their wide experience in the planning of city pumping, is available to city officials.

BRANCH OFFICES

CHICAGO, ILL. . . 20 N. WACKER DRIVE
LOS ANGELES, CALIF. . 416 E. THIRD ST.
KANSAS CITY, MO. . . COMMERCE BLDG.
NEW YORK, N. Y. 165 BROADWAY

DISTRICT SALES AGENCIES

ATLANTA, GA.	DETROIT, MICH.	OMAHA, NEB.	SEATTLE, WASH.
BIRMINGHAM, ALA.	EL PASO, TEXAS	PHILADELPHIA, PA.	ST. LOUIS, MO.
CAMBRIDGE, MASS.	HOUSTON, TEXAS	PORTLAND, OREGON	ST. PAUL, MINN.
CHARLOTTE, N. C.	JOPLIN, MO.	PORTALES, N. MEX.	TULSA, OKLA.
DALLAS, TEXAS	MILWAUKEE, WIS.	SALT LAKE CITY, UTAH	VANCOUVER, B. C., CANADA
DENVER, COLO.	NEW ORLEANS, LA.	SAN FRANCISCO, CALIF.	

THE AMERICAN WELL WORKS

General Offices AURORA, ILLINOIS and Factory

was built, and the final flume was built by Japanese and Filipino carpenters standing waist deep, braced against the stream, and driving nails under water.

A four-foot closure tunnel was left in the concrete poured in one section, the river passed through this tunnel and the wood flume was removed. Eventually this opening had to be sealed. This proved to be an exciting job. Every part of it was timed to a second. Concrete was mixed, forms made ready, and every workman carefully instructed in his part. A steel door was lowered over the opening. In a few minutes before the pool below the dam rose to the tunnel level, the last shovelful of concrete was shot in, and the rising water beaten by a breath.

While part of the engineering force struggled with the construction of the dam, another group pushed work on a tunnel. The Botocan river bends sharply below the falls before it joins the Dalituan. Owing to the high land which intervenes between the dam and top of the gorge above the power house, a tunnel 3,900 feet long and 6½ feet in diameter was drilled across the neck of land between the two rivers. The tunnel has a drop of 80 feet which is added to the pressure of the water when it finally hits the turbines. At its western terminus the tunnel connects with a pipe line, 2,620 feet long, 6½ feet in diameter, which carries the water to the top of the power house gorge.

When the water in the pipe line reaches the edge of the gorge, it is split into two parts, and drops a sheer 475 feet through the penstocks to the power house. The two lines of pipe of the penstocks are each 625 feet long with a diameter of four feet nine inches at the start, narrowing to four feet and six inches halfway down the hill.

Building the penstocks again taxed the courage of the engineers. Landslide after landslide wrecked the operations on the foundations for the penstocks. One avalanche tore out all the bulkheads and about 50 cubic yards of rock and earth. It crashed through one side of the power house and did considerable damage.

The huge pipes were built in five-ton sections at the top of the gorge and lowered into place by cable and anchored in concrete. During all the first days of this operation there was no way to get in and out of the gorge except to climb its almost inaccessible sides, clinging to bushes and rocks. It took a half hour for one man to climb. Later a cableway was constructed so that now communication with the power house is accomplished by means of a steel cage slung out over the gorge of Botocan and dropped 500 feet to its floor by cable.

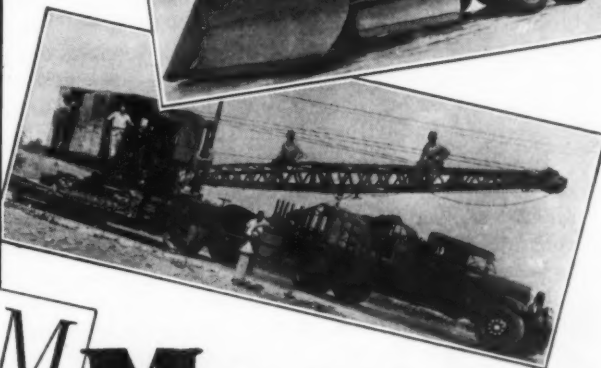
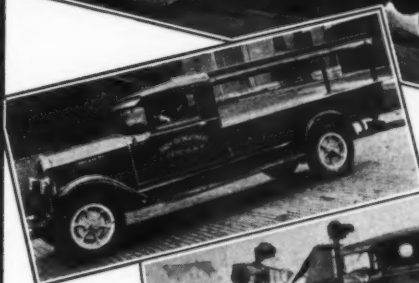
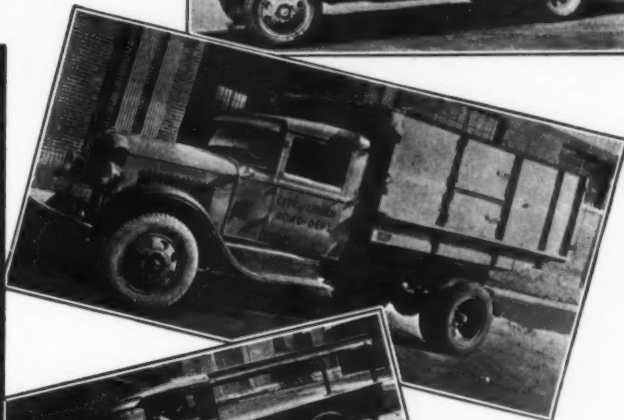
After completion of the penstocks, a network of cable and steel mesh with a series of fences was built to hold the cliff's side, until natural vegetation takes root and retains the surface earth.

The power house at the bottom of the gorge, built on the "Y" formed by the junction of the Botocan and Dalituan rivers, is of steel frame and re-enforced concrete walls. It is 33 feet wide, 94 feet long, with a steel switching structure on the roof. Water from the Botocan river, with a total head of 647 feet, comes flashing down the cliff side to spin two reaction type turbines that drive two 7,500 kw. electric generators. Another impulse type turbine is used to drive a 1,000 kw. generator. All of the generators supply power to Manila and the countryside around Botocan, but the smaller generator will be used solely for the latter purpose when the larger generators are not in operation.

(Continued on page 74)

IN POWER, RUGGEDNESS SPEED . . . PRICE

today's outstanding **TRUCK VALUES!**



ON hundreds of state, county and municipal jobs, General Motors Trucks are writing impressive performance records. One big reason is that each unit is exactly suited to its job. This is made possible by the unequalled completeness of this great truck line.

There is a modern 6-cylinder General Motors Truck accurately suited in power, speed and ruggedness for virtually any truck job that exists.

The line offers today's greatest VALUES. General Motors Truck advantages in engineering, manufacturing and purchasing were never more sharply evident.

Investigate these *General Motors Values!* That name tells you that every advance—of proved merit—in design and construction is found in these modern vehicles. *See them!*

GENERAL MOTORS TRUCK COMPANY, Pontiac, Mich.
(Subsidiary of Yellow Truck & Coach Mfg. Co.) GENERAL
MOTORS TRUCKS, YELLOW CABS AND COACHES. Factory
Branches, Distributors, Dealers—in over 2200 principal
cities and towns. (Time payments financed through our own
Y. M. A. C. plan at lowest available rates.)

GENERAL MOTORS TRUCKS

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 95

Practical Operation of Sewage Disposal Plants

(Continued from page 60)

be tolerated; but generally this growth must be kept down or serious ponding will occur. The application of chloride of lime occasionally, either to the dosing tank or scattered dry over the bed, has been very effective in keeping the bed free from growths. Ponding is frequently caused by improperly settled sewage or too fine material in the trickling filter. Cutting the bed out for a short time, or lowering the rate by dosing less often, usually helps. Carefully digging over the bed with pick or harrow is sometimes beneficial; but never punch holes with a crowbar to let the water down.

Passing the tank effluent through a screen about the size of fly-netting will save much work in caring for the nozzles, by removing match sticks, unsettled patches of fungus, and similar objects which cause stoppages in the nozzles.

The underdrains should be accessible, and should be kept cleaned out to prevent accumulation of sludge, worms or other material which would decompose and spoil the effluent. A bright, sparkling, or green algae condition at the underdrain outlets indicates a good performance of the filter; while foul, greyish or fungi conditions at the underdrains indicate a bad nozzle, a leak, ponding or overloading.

Contact Beds

The dose on contact beds should be regulated carefully to keep the rates below the maximum allowed, secure proper rotation and the proper times for filling, standing full, and especially rest between doses. Contact beds accumulate solids to an enormous degree and must be cleaned occasionally. This is expensive, because the stone must be removed to be washed. Everything which can be done to lessen cleaning results in economy. Proper tank treatment to remove suspended solids is imperative, and a straining filter, such as a barrier of fine cinders at the inlet to the contact beds, has proved invaluable. Surface distribution on contact beds is worthless, notwithstanding its prevalence at one time. The fewer the doses per day in contact beds the better; certainly not over four.

Sand Filters

Under proper conditions, sand filters give by far the best effluent of any single process, except perhaps broad irrigation. A recent book, quoting a well known chemist, says that activated sludge gives the world's best sewage treatment effluent; but the activated sludge process of itself cannot give an effluent anywhere near the quality of that from a good sand filter.

In order to get good results, it is imperative to have sufficient area, a sufficient number of beds to provide for proper sequence in dosing, perfect distribution, and adequate underdrainage to get the effluent away as soon as the dose gets through the bed. The operator will be required to see that the sand is kept clean and in a porous condition, that the bed gets an even dose all over, that the dose is cut off completely at the proper time without the continuation of a dribble, that the dose disappears into the sand quickly (not more than one hour after it has been cut off), and that the next dose follows not earlier than 12, or better 24, hours thereafter. Long intervals of rest between doses are beneficial; but standing full of sewage is fatal.

Asked once to explain the difference between the action of a trickling filter and a sand filter, I replied

that a man could walk the streets all day in the rain, but if he fell overboard he must soon come up for air.

Broad Irrigation

The oldest of all processes of sewage disposal may be passed over, because in New Jersey it is now necessary to conduct the sewage so far to find a suitable area that the process is going out of use.

Disinfection

The subject of the use of chlorine or other disinfectants, odor preventatives, fly exterminants and what not, is too big a subject for my limited time. The judicious application of chlorine avails much. It was in New Jersey, at the city of Red Bank in the summer of 1907, that the real beginnings of chlorine in sewage began. As I look back these twenty-four years, I am proud to be able to say that I was the fellow who did the sweating with the bleach that summer.

The operator's chief care is to keep the apparatus going all the time and not let the supply of chlorine run out.

Activated Sludge

This is still a special process, although plants are beginning to be more common. Time will not permit of a discussion so I can only advise those of you who may be connected with activated sludge plants to make a special study of the various principles and steps in the process. The dewatering and disposing of the sludge constitutes quite a problem in itself.

Tests and Records

It is most important that the operator have clear, concise and accurate records of the performance of his plant. This may save him his job, or save his town an expensive law-suit. He must know himself just what the plant is doing; but also he must have the data to prove to others at some later date what went on. This can be accomplished by *faithfully* making the prescribed tests laid down for him for his reports, and keeping a daily log of all activities and occurrences at the plant.

In making tests, care should be used to understand what the test is for and how it is made. Many tests have been utterly worthless because made at the wrong places or improperly performed by operators who did not understand the reason for them. Instructions frequently are given by an inexperienced or incompetent state inspector which cause the operator to be overworked and a mass of worthless data to be placed on file.

A competent operator will recognize such instructions and remind the inspector to make himself understood.

General

Keep the plant clean in all its parts, the surroundings attractive, and everything in a condition to excite favorable comments from visitors.

Floor of the Hudson River Bridge

The longest suspension span in the world, the bridge crossing the Hudson from New York City, is to be paved with concrete which will be made non-skid by drawing a broom transversely across the new-laid pavement. The concrete is to have a strength in 28 days of 4,000 pounds per square inch, being proportioned by the water cement ratio, using $5\frac{3}{4}$ gallons of water per sack of cement.



Revenue from Sewage Sludge

SEWAGE to waste, or fertilizer for the market . . . this is the question each community must decide when planning to treat sewage.

"Fertilizer for the market" should be the decision. To illustrate its value we might cite the case of Pasadena, California. Here, the sale of fertilizer (about six tons a day) more than offsets the labor costs for the entire plant. Also there is a considerable saving every year in the cost of treating over other methods.*

The community that is operating its activated sludge system followed by Oliver United Continuous Filtration will always be in a position to take advantage of a demand for fertilizer . . . and at a good price. Or it can use the fertilizer on its own farms, thus saving costs there.

In any case, costs for treating sewage by the activated-sludge, continuous filtration method are low. It is the method for the economical community.

*These statements by City Engineer, Pasadena, California.

**OLIVER
UNITED FILTERS
INC.**

SAN FRANCISCO
Federal Reserve
Bank Bldg.
NEW YORK
33 West 42nd St.
CHICAGO
565 Washington
Blvd.



Factories:
Oakland, Calif., Hazleton, Penna.,
Peterboro, England
Cable Address OLIUNIFILT

LONDON, W.C. 1
150 Southampton
Row
PARIS
T. L. Genter,
Concessionaire,
63 Ave. des
Champs Elysees

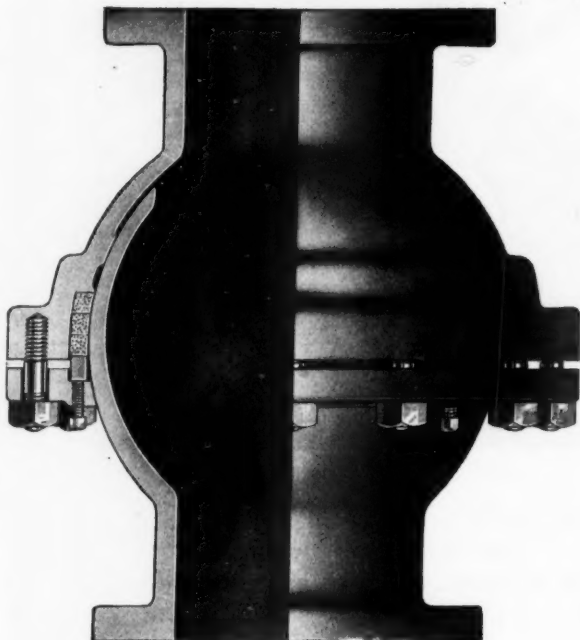
AGENTS

TIMMINS, ONTARIO	B. D. Kelly	TOKYO	American Trading Co., Inc.
HALLE, GERMANY	Wilhelm Lill	MELBOURNE	Fyvie & Stewart
SCHEVENINGEN, HOLLAND	and SOERABAIA, JAVA	HONOLULU	W. A. Ramsay Co.
RECIFE, BRAZIL	Ayres & Son	MANILA	The Edward J. Nell Co.
JOHANNESBURG	E. L. Bateman (Pty.), Ltd.	STOCKHOLM SWEDEN	T. An. Tesch

BARCO

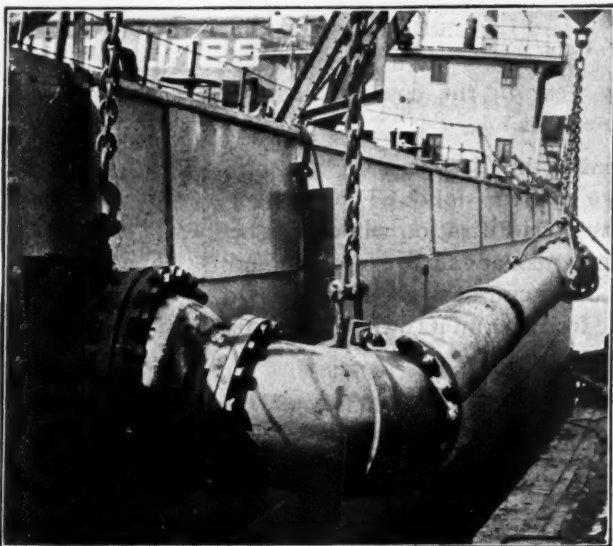
Flexible Joints

Provide Combined Angle and Swivel Movement



Flange Ends 4 to 48 inches

OVER 1,000,000 IN SERVICE



Barco Joints on Suction Dredges

BARCO MANUFACTURING CO.

1800 WINNEMAC AVE.

CHICAGO, ILL.

**THE HOLDEN COMPANY LIMITED
IN CANADA**

Montreal—Toronto—Winnipeg—Vancouver

The Effect of the Drought on Maryland Water Supplies

The deficiency in rainfall in Maryland during the year 1930 has had a very noticeable effect upon the public water supplies throughout the State. The flow of practically all surface streams has dropped below normal and some of the smaller streams are almost dry. The underground water level has dropped to such an extent that many springs and shallow wells have dried up. As nearly seventy per cent of the population of the State depend upon surface streams for water supplies, the seriousness of the present situation is apparent.

Havre de Grace obtains its water supply from the Susquehanna river at the head of Chesapeake Bay. Although the quantity of water available has been ample, objectionable tastes have occurred therein, due to the increased salt content of the water resulting from the diminished flow of the river; the chloride content having increased from a former maximum of 9 parts per million to 582 parts per million. At present the water is not palatable, and many of the residents are using water from wells and springs.

Annapolis found it necessary to obtain an auxiliary supply from a stream located a short distance from the water plant, but the quantity of water was barely sufficient to meet the demand, and later, an additional supply was obtained from the United States Naval Academy. About the first of October, the municipal authorities entered into a contract for the construction of a large-diameter well which was guaranteed to deliver 1,000,000 gallons of water per day.

At Port Deposit it was necessary to pump water from the Susquehanna river into the town's distribution system. This supply is heavily chlorinated at all times to insure a safe water.

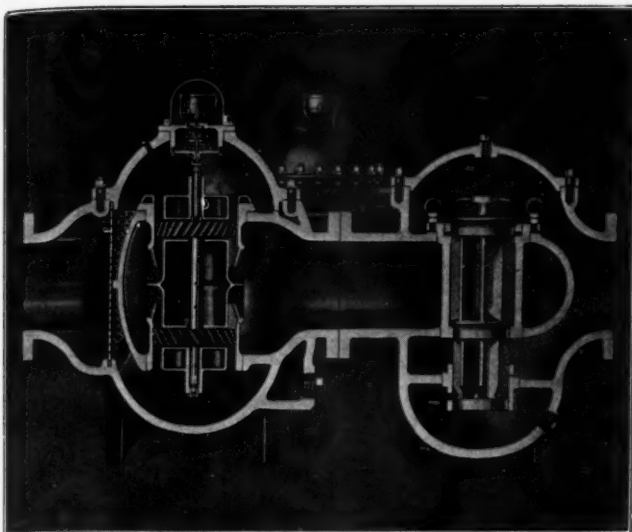
The Brunswick water supply, which comes from springs located in Virginia, became so low that it was necessary to get additional water from the Potomac river. This supply is pumped into the town's distribution system, after chlorination, by the Baltimore and Ohio Railroad.

The streams supplying Barton and Barrellville have practically dried up. The residents of both communities have been forced to utilize individual wells and springs in the vicinity to obtain drinking water.

Dorsey Run, source of water supply for many years of the Maryland House of Correction, failed, and it was necessary to go approximately three miles to the Little Patuxent river. The work was completed in record time, water from the river being pumped into the existing reservoir within two weeks from the time of the beginning of the work.

At Pocomoke City the old and new wells on the municipal water works have been unable to supply the demand, and restrictions have been placed on the use of water in order to prevent a serious shortage.

Probably the greatest effect of the drought, so far as the number of people is concerned, was in the Washington Suburban Sanitary District, where the flow of Northwest Branch, the source of water supply for the District, was exceedingly low. With the two main filter plants and an auxiliary plant unable to meet demands because of insufficient water, the District would have been in a precarious condition were not the water supply of the District of Columbia available. Nearly the entire amount of water used was obtained from the Washington supply through several connections between the two systems.



INCONSTANCY "MOTHERED" THE SMITH-FEDERAL COMPOUND WATER METER

—But the Smith-Federal Compound Water Meter Is Itself Far from Being Inconstant!

SINCE "Necessity is the Mother of Invention," it was the inconstancy of the water demand on many large metered services that "mothered" the Smith-Federal Compound Water Meter.

For instance, many large industrial plants have maximum water needs during certain morning and afternoon hours, but their night and noon-hour water needs are negligible. It was to meet just such inconstancy as this that this meter was perfected.

SMITH

SMITH - FEDERAL
COMPOUND METERS

But the Smith-Federal Compound Water Meter is itself the acme of constancy, since it will measure either the minimum or the maximum flows with the greatest accuracy. In the case of the former, the water is shunted through a by-pass, to be measured by a small, auxiliary disc meter. But whenever the flow increases to a certain point, an automatic controlling-valve mechanism returns the water through the large current meter, with its measuring cage and wheel unit. The change-over, either up or down, is instantaneous.

Send for Complete Description

ILLUSTRATIONS

Above: Cross Section of Smith-Federal Compound Water Meter, size 4-inch x 1-inch

Below: Current Meter - Measuring Cage and Wheel at Left and Controlling-Valve Cage and Valve-Plug at Right



Smith Tapping Apparatus—Tapping Sleeves and Valves—O'Brien Hydrants—Valve-Inserting Machines—Lead-Melting Furnaces—Removable Plugs—Pipe-Cutting Machines—Corporation Tapping Machines—Corporation Cocks of Every Type—Federal Meters



THE A.P. SMITH MFG. CO. East Orange, N.J.

There's Money in Dirt



Moving the WARCO Way

WARCO Wheeled Scoops dig, haul, dump, and spread without stopping. One man handles a train of three or more.

New illustrated literature is ready.
May we send it to you?



W. A. RIDDELL COMPANY
BUCYRUS . . . OHIO

Power Graders—Wheeled Scoops—Rear Crawlers

STANDARD Asphalt Products

Standard Asphalt Binder A (Socony Brand) for surface treatment
Standard Asphalt Binder B (Socony Brand) for penetration work
Standard Asphalt Binder C (Socony Brand) for the mixing method
Standard Cold Patch Asphalt (Socony Brand) for repairing all types of bituminous road surfaces
Standard Refined Asphalt (Socony Brand) for sheet asphalt paving
Standard Asphalt Joint Fillers (Socony Brand) for brick or block pavements

Standard Paving Flux
Standard Bridge Asphalt
and Preserving Oils.

STANDARD OIL CO.
OF NEW YORK
26 Broadway



When writing, please mention PUBLIC WORKS

(Continued from page 68)

eration and if the transmission to Manila is out of service.

By December 1, 1930, the power house and generating machinery was completed and the transmission line had been set up. When construction was begun on the 55-mile transmission line from Botocan to Manila, it was expected that the line which traversed swamps and jungles could be completed in the dry season. There was hardly any dry season, so the wires had to be strung under incessant rains and frequent typhoons. In the 12 miles between Taytay and Mabitac, trucks and tractors travelled through water two feet deep, and where the ground was even impassable for water buffalo, known as carabao, men carried sections of the 2½-ton towers on their shoulders to the points of erection.

The line is strung on steel transmission towers and carries 110,000 volts, the highest voltage in the Orient. The line terminates in the suburbs of Manila, where at Santa Mesa there was erected the most powerful substation in the Philippines and perhaps in the East.

Communication between the job and Manila during a part of the construction period provided perplexing problems. A double bare-wire was strung first between Botocan and Pagsanjan Wharf, but service was continually interrupted by rains and by coconut leaves falling across the wires and causing grounds. By substituting insulated wires for this, satisfactory service was finally achieved. Communication with Manila was first accomplished through telephone relays and telegraph, but radio was finally used and proved highly valuable.

Highway Policies in Several States

(Continued from page 38)

more important county roads, and thereby relieve the people of the counties of a part of their road taxes."

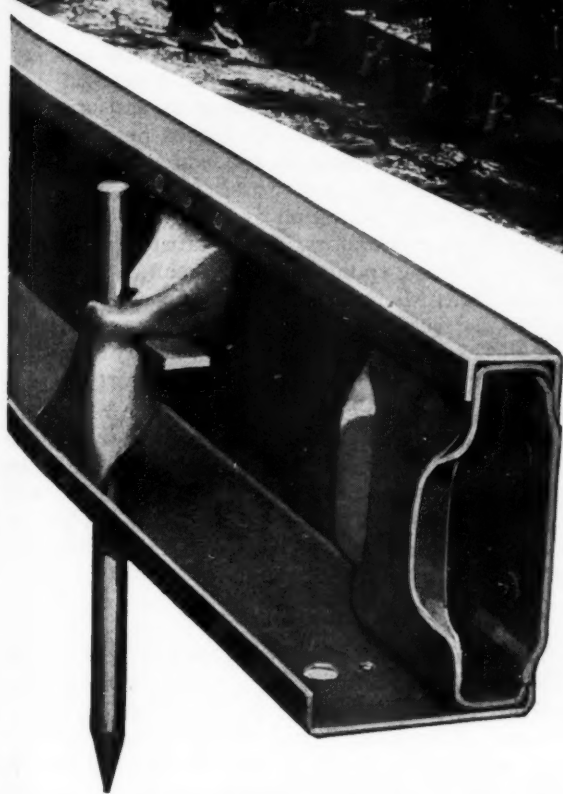
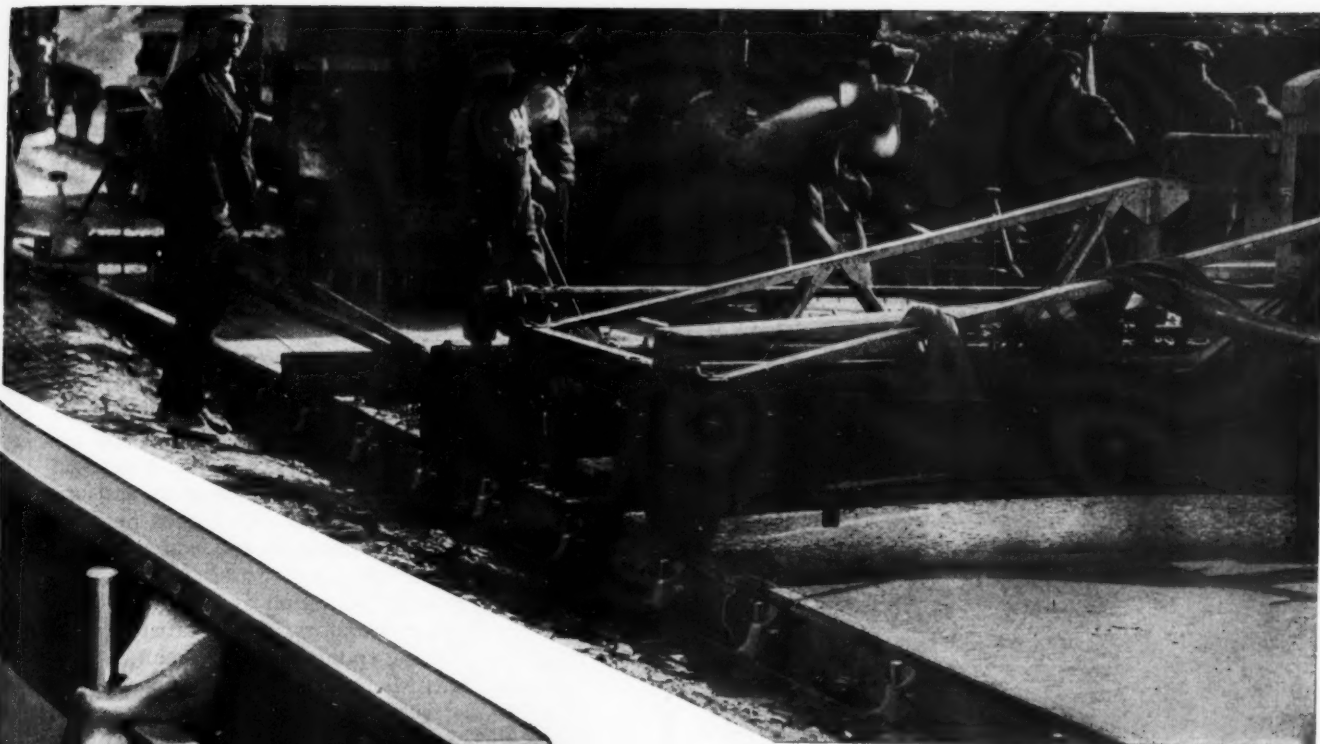
Miscellaneous

California.—"Recognizing the unjust disproportion of secondary mileage as between the northern and the southern portions of the State, I transmitted a message to the Legislature recommending that it pass a resolution directing the California Highway Commission and the Department of Public Works to make a study and survey of the problem to determine what roads should be added to the system, and also recommending that the existing discrepancy be relieved by 'the addition of three or four times as much mileage in the south as in the north.' A week later this requested resolution was passed by both houses, and the proposed survey and report has since been made, thus carrying out the policy and establishing the precedent upon which the administration had insisted, 'that expert study by State authorities must precede, rather than follow the inclusion of roads into the State highway system.'"

Maine.—"It is wiser, however, to proceed at a steady rate each year rather than to have a great amount of construction one year and none the next. A steadily employed engineering force is of more value than one hastily assembled to be soon disbanded."

Pennsylvania.—"Systematic planting of trees and shrubs has been carried on not only for the beautification of the highways but as a protection against storms and the erosion of slopes."

(To be continued)



HELTZEL SUPERIOR LOCK ROAD FORMS

LOWEST COST PER MILE OF USE

Other HELTZEL Products

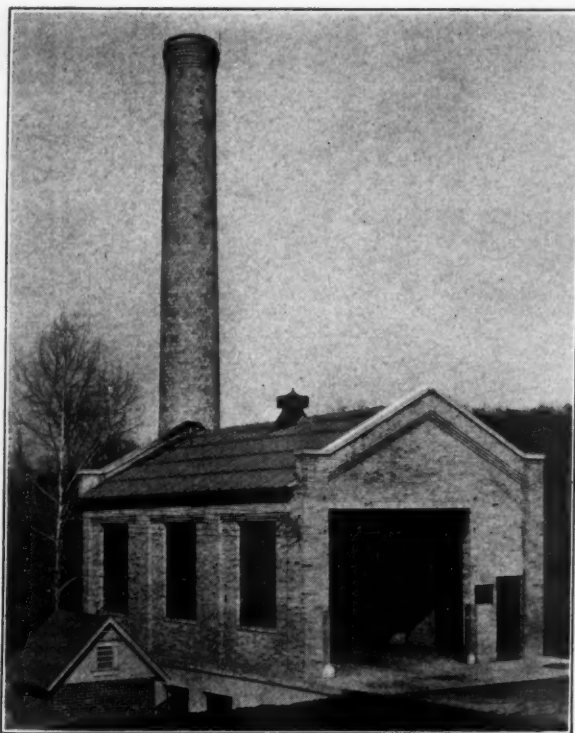
Aggregate Weighing Plants,
Portable Bulk Cement
Plants, Steel Curb and Gut-
ter Forms, Steel Sidewalk
Forms, Trail Graders,
Travelling Bridges, Straight
Edges, Hand Screeds, etc.

More than twenty important features of construction are combined to make Heltzel Superior Lock Road Forms unusually strong, durable, and long-lived. Only Heltzel incorporates all of these features in road form design. Because of this extra strength, Superior Lock Road Forms will build a maximum mileage of concrete road with extremely low up-keep costs. Rails will not become bent or twisted, stake pockets will not come loose, and form-setting is faster and easier.

Write today for literature giving full details about Heltzel Superior Lock Road Forms.

THE HELTZEL STEEL FORM & IRON CO., WARREN, OHIO

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 95



"Pittsburgh-Des Moines" Incinerators for the Smaller Communities

Coraopolis, Pa. is a clean community ten miles northwest of Pittsburgh on the Ohio river. It had a 1930 census of 10,718. In 1929 the municipal officials called on "Pittsburgh-Des Moines" for an adequate garbage disposal plant.

The modern incinerator illustrated above now disposes of all the town's garbage and rubbish every day. It is efficient, economical, smokeless, odorless and simple to operate. Its rated capacity is 35 tons every 24 hours.

Small villages and towns have also discovered the advantages of scientific incineration for garbage and refuse disposal. This modern disposal method is available at a cost they can easily afford. . . . Some of the outstanding advantages of the "Pittsburgh-Des Moines" incinerator plant are:

- 1—A dependable economic performance record at 1500° Fahrenheit or above.
- 2—The utilization of ALL the garbage as fuel—resulting in big fuel savings and low operating costs.
- 3—Selective charging of fresh garbage to any cell of the furnace.
- 4—Short and easy "all pull" stoking.
- 5—Simplicity of operation and fool-proof construction.

Interested municipal officials should write to our nearest office for our new Incinerator Catalog describing the PDM Mutual Assistance Type of Furnace.



State your population and write today for your copy
of the new PDM Incinerator Catalog.

Pittsburgh-Des Moines Steel Company

3454 Neville Island Pittsburgh, Pa. Room 942, 270 Broadway New York City, N. Y. 955 Tuttle Street Des Moines, Iowa

ATLANTA—CHICAGO—DALLAS—SAN FRANCISCO—SEATTLE

When writing, please mention PUBLIC WORKS

The Water Wheel

(Continued from page 47)

the raw water was carrying taste-producing algae.⁴⁴ Gibbons did not find the ammonia-chlorine process able to assist in improving tastes at Rahway, New Jersey, but **activated carbon** was helpful.

The **cleaning of dirty filter sands** is discussed by Stup,¹ who mentions eight different processes. Acid treatment is not recommended, but alkalis, chlorine and violent handling by ejectors are preferred in different conditions.

Training of operating personnel in North Carolina is discussed by J. Summie Whitener,³⁷ himself a product of the system inaugurated by the engineering division of the State Department of Health, and now carried on by the state university. This system provides instruction for non-technical operators and also supplies technical operators who have been put through a formal training in sanitation and water supply. The technical men are able to give assistance in sewage disposal and in milk sanitation as well as to act in the capacity of filter operators. A less satisfactory scheme is indicated in the training of non-technical personnel at Saint Clair, Michigan,⁶⁸ where local conditions are said to have permitted whipping into shape as operators and analysts two non-technical appointees at the water works. This required a period of thirty days.

Zeolite softeners are treated extensively in an annotated bibliography on greensand issued by the Bureau of Mines.¹⁰ The **concentration of the waters of boilers** and the rational control of the concentration of salts in them is described by Whitton.⁴⁷ The waters discussed have been softened and salts are considered as the sodium salts of various acids.

Laboratory

The **typhoid epidemic** which visited Olean, New York, in 1928 as a result of the pollution of its water supply is reported in detail by Archibald S. Dean.⁴ The time of appearance and disappearance of the typhoid organisms in the feces and the urine of the persons having contracted the disease is probably the most interesting part of the paper to those who have made a special study of such epidemics. The well-known treatise on the Elements of Water Bacteriology by Prescott and Winslow has appeared in a 5th Edition.⁷⁶

The practical use of the determination of hydrogen ion concentration, or as it is usually called, the **determination of the pH**, is described by Boynton.⁶⁹ A **bottle** for the collection of **water samples** as used by the Missouri State Board of Health is shown and explained by Laybourn.⁵ The purpose of the design is to avoid contamination of the stopper by laying it down while filling the bottle.

The **mottling of the enamel** of the permanent teeth of children who pass the years when the teeth are coming in in certain areas, has been noticed by many observers. Kempf and McKay⁵⁸ give the status of the subject without mentioning any suspected element in the character of the water which seems to be responsible. (Reference No. 29 in the Water Wheel for April, entitled Dental Deficiencies and Drinking Water, by R. W. Kehr, Journal of the American Water Works Association, Volume 23, No. 2, pp. 214-229, (February, 1931), may profitably be consulted in this matter.)

Swimming pool administration in Detroit has reached a high degree of adequacy under William H. Cary, Jr.,



WILLIAMSPORT
*wire rope will handle
that tough job for you*

—and will do it in a manner that good
engineers and contractors appreciate

Your copy of our 1931 catalog
and data book is just off the
press. It contains a vast
amount of valuable informa-
tion. Send for it today.

WILLIAMSPORT WIRE ROPE CO.

Main Office and Works:
Williamsport, Pa.

General Sales Offices:
122 So. Michigan Ave., Chicago

LAYING 12 INCH McWANE CAST IRON PIPE



Piping Prosperity Back!

A part of your community's prosperity is "home-made"—the local expenditures that stimulate local business.

So doing needed water-main laying now—while money, labor, and pipe are low in cost—helps locally and immediately wherever done. As well as benefiting labor engaged in transportation and mining industries elsewhere.

And half the battle is in doing it now, this Spring, while costs are still low and unemployment lending urgency. Why not send us a list of your pipe needs, for quotations and full data?

More Main Per Dollar

McWane Cast Iron Pipe gives you the most main per dollar. Sand-cast yet modern in weights, strengths, lengths, and uniformity. A superior bell and spigot pipe in sizes 1¼ through 12 inches. With or without famous Precalked Joints. Fittings. Address:

**McWANE
CAST IRON
PIPE CO.
BIRMINGHAM
ALABAMA**



**PACIFIC
STATES
CAST IRON
PIPE CO.
PROVO, UTAH**

Chicago—208 S. LaSalle St.
Dallas—1807 S. F. Bldg.
Los Angeles—417 S. Hill St.
Denver—226 Cont'l Oil Bldg.

New York—40 Exchange Place
Kansas City—1006 Grand Av.
San Francisco—111 Sutter St.
Portland, Ore.—611 Spalding Bldg.

and his description of the means employed is authoritative.⁷ Requirements for a safe water for pools in West Virginia have been worked out by the engineering division of the State Department of Health, and their conclusions have been arrived at after much experience. Consequently they merit the attention of persons who are responsible for the purification of the pool water and the upkeep of the installations.⁵¹ Ammonia and chlorine are being used with advantage in the treatment of pool waters as of city water supplies.⁹

The Drought

A rain of 2 to 3½ inches during the last few days of March was experienced in the Southeast and proved to be a great help to the drought-stricken communities in that territory.³² Missouri,¹⁶ Kentucky²² and West Virginia³⁰ conditions were often serious. An emergency supply from the mains of the East Bay Municipal Utility District helped San Francisco in the emergency.²³ A suprising thing about the streamflow in South Dakota and Nebraska was the finding that there was no general relationship between the precipitation and the runoff under the conditions during the summer.²⁶

Bibliography of Recent Water Works Literature

- *The three leading articles.
The American City, Volume 44, No. 4 (April, 1931).
 1. Cleaning Dirty Filter Sand, Harry C. Stup, page 7.
 2. The Colorado River Aqueduct for the Los Angeles Metropolitan District, W. A. Scott, pp. 86-88.
 3. New 80 Foot Diameter Steel Water Tank for Cedartown, Georgia, J. E. Rainwater, page 133.
Amer. Journal of Public Health, Vol. 21, No. 4 (April, 1931).
 4. The Olean City Epidemic of Typhoid Fever in 1928, Archibald S. Dean, pp. 390-402.
 5. An Improved Water Sample Bottle, Ross L. Laybourn, pp. 418-419.
 6. Control of Cross Connections in Texas Cities, W. N. Dashiell and Edgar Whedbee, pp. 426-429.
Beach and Pool, Volume 5, No. 3 (March, 1931).
 7. Municipal Administration of Swimming Pools in Detroit, Wm. H. Cary, Jr., pp. 10-13, 35-38, 51.
 8. A Safe Water Supply for Your Pool, pp. 17-19, 44-45, 55-56.
Beach and Pool, Volume 5, No. 4, (April, 1931.)
 9. The Use of Ammonia with Chlorine, F. D. West, pp. 85 and 88.
Bureau of Mines Publications.
 10. Green Sand Bibliography to 1930 (Annotated), with a Chapter on Zeolite Water Softeners, R. Norris Shreve, Bureau of Mines Bulletin No. 328, U. S. Dept. of Commerce, 1930, pages 78, 15 cts.
Canadian Engineer, Volume 60, No. 14 (April 7, 1931).
 11. Successful Water Works Operation, R. H. Corey, pp. 23-25, 60, 62.
 12. Bradford Water Supply System, page 27.
The Engineer (London). Vol. 151, No. 3924. (March 27, 1931).
 13. Modern Methods of Raising Water from Underground Sources, Rupert S. Allen and W. E. W. Millington, page 341. (Continued.)
The Engineering News-Record, Volume 106, No. 10 (March 5, 1931).
 14. Rapid Field Studies Made of Reservoir Sites, J. Albert Holmes, pp. 386-388.
 15. Diversion of Connecticut Tributaries for Water Supply of Boston Upheld, pp. 399-401.
 16. Water Supply Conditions in the Drought Areas, pp. 405-6.
The Engineering News-Record, Volume 106, No. 11 (March 12, 1931).
 17. Status of Water Development in Eleven Western States—Symposium, pp. 428-431.
 18. Problems in Concrete Dam Design, D. C. Henry, pp. 431-435.
 19. Ariel Dam—An Example of Modern Dam Construction Practice, pp. 435-438.
 20. Developments in Western Municipal Water Supply Practice, Harry N. Jenks, pp. 438-440.
 21. Plans for Sewage Reclamation in the Los Angeles Metropolitan Area, R. F. Goudey, pp. 443-446.
 22. Field Notes on Water Supply Conditions in the Drought Area, pp. 452-454.
 23. Delivery of Emergency Water to San Francisco Begun, page 457.
 24. Hetch-Hetchy Water Tunnel Sixty Percent Completed, page 459.
The Engineering News-Record, Volume 106, No. 12 (March 19, 1931).
 25. Design of a Ninety Foot Circular Low-Lift Pumping Plant, pp. 468-472.
 26. Streamflow Differences in 1930 drought, Robert Follansbee, page 473.
 27. Water Works Practice Abroad, pp. 480-481.
 28. Sacramento Votes Bonds for New Sedimentation Basin, page 500.
The Engineering News-Record, Volume 106, No. 13 (March 26, 1931).
 29. Sloping Cutoff Wall Is Economic Feature of Rolled Earth Dam, page 522.
The Engineering News-Record, Volume 106, No. 14 (April 2, 1931).
 30. Water Supply Conditions in the Drought Regions, F. W. H., pp. 565-7.



In inset—close-up cross-section of meshed gears, showing case hardening.



OLD *in working days* **YOUNG** *in mechanical condition*

Surprisingly fit after many months of work like this. Tough alloys are used unsparingly. Bearings are dirt protected. Carburized (case-hardened) gears turn smoothly in oil, giving you more of trouble-free working days—extra return on your investment.

**A
free
trial**
on your job
Ask your Dealer

Monarch "75," "50" and "35" track-type tractors. Model "U" wheel and track-type tractors and power units

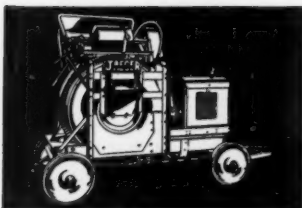


ALLIS • CHALMERS • TRACTORS

SPRINGFIELD, ILLINOIS . . . MILWAUKEE, WISCONSIN

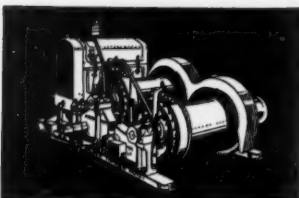
For latest catalogs—consult the classified INDUSTRIAL LITERATURE section, beginning on page 95

1931 NEWS!



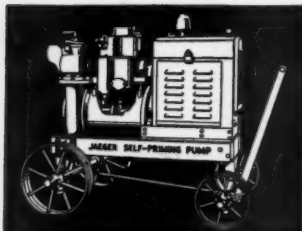
PUMPS

Increased power and capacity, with weight reduced. All sizes, types- New 1931 prices.



MIXERS

3½S to 84S sizes. Improved "Dual-Mix" Tilters, heavy duty Non-Tilters. Equipped for every need.



HOISTS

Timken Screw Thrust type; more power, more speed and ease of operation. Single, double drum. Gas, electric.

Send for JAEGER CATALOG..PRICES

THE JAEGER MACHINE CO.
400 Dublin Avenue, Columbus, Ohio



A Guest at the Morrison enjoys all the luxuries that only a hotel of premier standing can offer. Yet rates are remarkably low—\$2.50 up—because sub-rentals pay all the ground rent. The saving is passed on to guests.

Every room in the Morrison Hotel is an outside room, with bath, circulating ice water, bed-head reading lamp and Servidor. A housekeeper is stationed on each floor.

The Morrison is the World's Tallest Hotel—46 Stories High.

Nearest Hotel in the City to stores, Offices, Theatres and Railroad Stations.

CHICAGO'S
MORRISON HOTEL

Corner Madison and Clark Streets

2500 Rooms
***2.50 Up**

When writing, please mention PUBLIC WORKS

31. New York City Planning an Additional Water Supply Development, pp. 573-574.
32. Rains in Southeast Augment Domestic Water Supply, page 578.
33. Phoenix, Arizona, Water System Improvements, page 581. *The Engineering News-Record*, Volume 106, No. 15 (April 9, 1931).
34. *Equipment's Place in Tunneling Progress (a Symposium). John S. McDowell, et al., pp. 601-619. *Journal of the American Water Works Association*, Volume 23, No. 3 (March, 1931).
35. The Advance Planning and Operating Results at Chicago, Loran D. Gayton, pp. 327-336.
36. Diesel Engines for Water Service, Rodney D. Hall, pp. 337-353.
37. Training Operating Personnel for Small Purification Works, J. Summie Whitener, pp. 354-372.
38. Successful Super-Chlorination and Dechlorination for Medicinal Taste of a Well Supply, Jamaica, Frank E. Hale, pp. 373-386.
39. Progress in Superchlorination Treatment for Taste Prevention at Toronto, Ontario, N. J. Howard, pp. 387-395.
40. The Elimination of Taste and Odor in the Water Supply of Lancaster, Pennsylvania, Edward D. Ruth, pp. 396-399.
41. Pre-Ammoniation of Filtered Water Supply of Cleveland, Ohio, J. W. Ellms, pp. 400-407. Discussion to page 413.
42. Water Works Accounting in Privately Owned Plants, P. Paul de Moya, 414-421.
43. What Should a Water Works Superintendent Make of His Job? W. Scott Johnson, pp. 422-429.
44. Taste and Odor Troubles in the Minneapolis Water Supply, Frank Raab, pp. 430-434.
45. Turbidity, Plankton, and Mineral Content of the Detroit Water Supply, Bert Hudgins, pp. 435-444.
46. *Power Plant Engineering*, Volume 35, No. 8 (April 15, 1931).
47. Vertical Circulating Pumps Prove Popular, pp. 445-447.
48. Concentration Control of Boiler Water, Herbert S. Whitton, pp. 452-454.
49. *Proceedings of the American Society of Civil Engineers*, Volume 57, No. 3 (March, 1931).
50. Flow of Ground Water as Applied to Drainage Wells, M. R. Lewis, pp. 411-423.
51. Gravity Dams Arched Down Stream, B. J. Lambert, pp. 425-430.
52. *Proceedings of the American Society of Civil Engineers*, Volume 57, No. 4 (April, 1931).
53. *Run-Off—Rational Run-Off Formulas. R. L. Gregory and C. E. Arnold, pp. 561-622.
54. *The Surveyor (England)*, Volume 79, No. 2044 (March 27, 1931).
55. Open Air Swimming Pool Construction, page 383.
56. *La Technique Sanitaire et Municipale*, Volume 26, No. 3 (March, 1931).
57. Emploi du chlor pour la stérilisation dans les distributions d'eau rurales, pp. 50-54.
58. *Water Works Engineering*, Volume 84, No. 5 (March 11, 1931).
59. Determining Compensation for Land Taken by Condemnation, Leo T. Parker, pp. 293-294, 329-330.
60. Water of Highly Variable Turbidities Handled by New Dallas Plant, L. C. Billings, pp. 296-297, 310, 313.
61. Massachusetts Wins Right to Divert Water for Boston. Harry Belknap, page 300.
62. *Water Works Losses—How They Can Be Avoided, Frank C. Jordan, pp. 295, 313-314, 317-318.
63. *Water Works Engineering*, Volume 84, No. 6 (March 25, 1931).
64. Creating a 600 Million Gallon Reservoir with a \$30,000 Dam, James P. Wells, pp. 355-356.
65. Certain Waters Discolor the Enamel of Permanent Teeth during Growth, Grover A. Kempf and Frederick S. McKay, pp. 357-358, 374-377, 378-381.
66. Experiments in Chloramine Treatment for a Highly Turbid Water Supply, C. L. Ehrhart, pp. 359-360, 394.
67. Increasing Water Storage Through the Use of Raised Tanks, A. B. Hirling, pp. 381-382.
68. Removing Tastes from a Badly Polluted Water, Mortimer M. Gibbons, pp. 389-390, 393.
69. *Water Works Engineering*, Volume 84, No. 7 (April 8, 1931).
70. Drought and Its Remedy, James P. Wells, pp. 429-430 and 468.
71. Bringing a Water System-Up-to-Date Without the Aid of a Bond Issue, J. C. Gordon, pp. 431-432, 466.
72. Cleveland Uses Ammonia-Chlorine to Check Phenol Tastes. M. M. Braidech, pp. 433-434, 454, 457-458, 461.
73. Legal Aspect of Property Valuation for Rate Making Purposes, Leo T. Parker, pp. 435-436, 462.
74. Choosing the Site and Constructing the Well, A. G. Fiedler, pp. 444-446.
75. Water Works Preparedness in the Matter of Fire Protection, Harry J. Corcoran, pp. 450 and 453.
76. Untrained Personnel Is Quickly Whipped into Shape, page 465.
77. Practical Use of pH Sets in Laboratory Control, Perkins Boynton, page 469.
78. *Water Works and Sewerage*, Volume 78, No. 3 (March, 1931).
79. Ammonia Chlorine Reactions and Lime Chlorine Process, L. H. Enslow, pp. 55-9.
80. Precipitation Records and Effective Rainfall, Alfred S. Malcolmson, page 60.
81. Filtration Plants: Settling Basins for Coagulated Water, John R. Baylis, pp. 61-65. (Continued.)
82. Notes from a Superintendent's Reports. W. H. Lawrence, page 66.
83. Diesel Engines as Applied to Water Works Service, R. D. Hall, pp. 70-73.
84. Politics and Water Works Management, F. M. Randlett, pp. 74-76.
85. BOOK.
86. Elements of Water Bacteriology, with especial reference to Sanitary Water Analysis, S. C. Prescott and C.-E. A. Winslow, 5th Edn. Revised, 8vo., viii plus 219 pages, John Wiley and Sons, New York.

THOUSANDS OF DOLLARS \$ \$ \$ \$

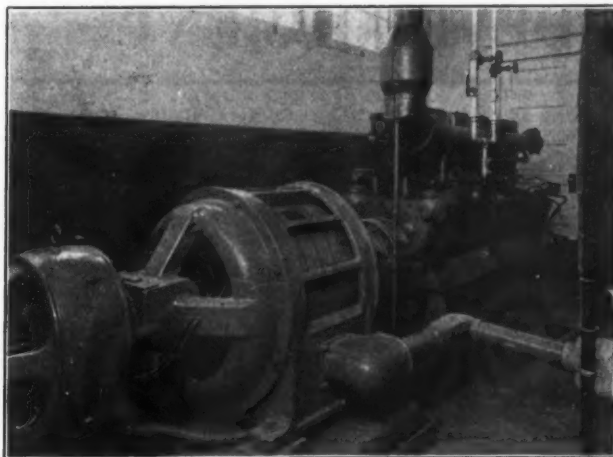
*are saved by this quick starting
installation when utility
power fails.*

**Sterling
High
Duty**



**Internal
Combustion
Engines**

**12 to 565 B.H.P.
Gas or Gasoline**



Schott's Bakery, Houston, Texas, operated electrically, has employed this standby unit on several occasions to save bread from loss. A 150 K.V.A. 1200 R.P.M., G. E. generator is driven by a direct connected straight 8 cyl. Sterling 240 H.P. engine.

STERLING ENGINE COMPANY

1270 NIAGARA STREET

Home office and plant

BUFFALO, N. Y.

900 CHRYSLER BUILDING

DEPT. C-5

NEW YORK, N. Y.

Chemicals For Water Purification For Treatment of Sewage **LIQUID CHLORINE**

Single Unit Tank Cars

Multi-Unit Tank Cars
(1-Ton Containers)

150-lb. Cylinders

**Chloride of Lime
Sulphate of Alumina**

Highest Grades. Manufactured by

Pennsylvania Salt Manufacturing Co.



New York

Executive Offices: Widener Building, Philadelphia
Representatives

Pittsburgh

Chicago

St. Louis

Works:

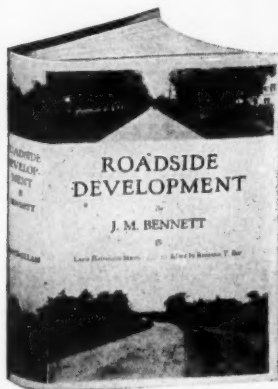
Philadelphia and Natrona, Pa.

Wyandotte and Menominee, Michigan

ROADSIDE DEVELOPMENT

By J. M. Bennett

Based on 10 years' actual experience and supervision of work costing millions of dollars, this new book by J. M. Bennett is invaluable to



Highway Officials
Contractors
Engineers
Public Utilities
Nurserymen
Manufacturers
Park Commissions

and others concerned with every phase of roadside development.

102 Illustrations

Price, \$5.00, postpaid

Publishers: PUBLIC WORKS

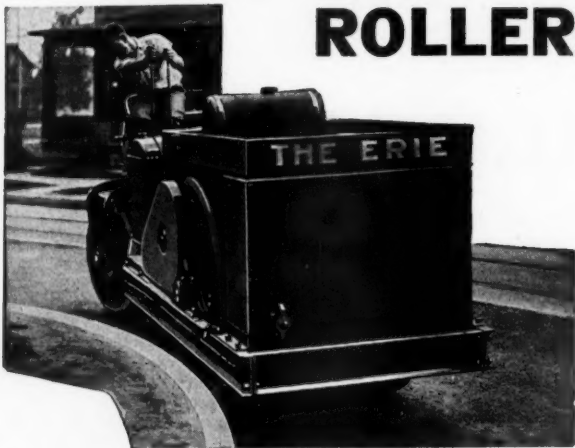
310 East 45th St.
New York, N. Y.

O. K. Please send me postage prepaid one copy of **ROADSIDE DEVELOPMENT** by Bennett.

NAME

ADDRESS

Pavements cost you less when rolled with **ERIE ROLLERS**



You get these features in an ERIE

Instant smooth reversing
Guaranteed high compression
Uniform hardness from curb
to curb
Minimum of hand tamping
Better factory service

Greater flexibility for cross
rolling
Balanced weight, preventing
sinking in or bridging
Clear view for the operator
Unequaled ease in steering

Write for catalog today.

Erie Machine Shops, Erie, Pa.

Roller Specialists for 40 years.

When writing, please mention PUBLIC WORKS

Operating Motor Trucks Profitably in Contracting

(Continued from page 25)

D. The storage shed expedites the loading of equipment.

Three Ways to Speed Up Loading.—While a "straight-driving" layout, which enables the trucks to move through the yard without needless stopping or backing, is one of the prime requirements in saving time in loading, three other important features are also found in the yards of contractors who have been most successful in avoiding loss of time in loading their trucks:

1. An easily accessible yard office with a slide-panel window for handing out orders. This discourages drivers from coming in for "conversation." And if the order superintendent has a commanding view of the yard, drivers are more likely to load faster.

2. A loading platform opening directly out of the small parts supply room, so that bags and boxes of fittings, or similar supplies, can be swung directly onto the truck.

3. A record-machine system of order keeping, with order forms large enough to assure all data necessary to facilitate prompt loading and perfect records.

Loading Routine Requires System.—Much irregularity in handling orders and dispatching trucks can be avoided by adopting the time-clock system of stamping orders. All orders should be time-stamped at three stages:

—As soon as received

—When given to the driver

—When the receipted copy is returned to the office.

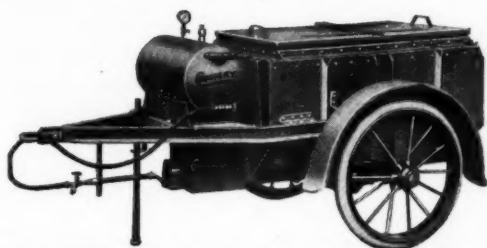
One chief advantage of this method in handling orders is that it leaves no loopholes for evading responsibility. Moreover, it develops the consistent habit of thinking in terms of time requirements—an essential factor in all phases of contract work.

Loading Improvements Pay Dividends.—While improvements in loading methods are not always practicable, at economical cost, they are always worth considering. In one case, for instance, a plumbing contractor who maintained his own warehouse installed his small parts stock room on the second floor, when he moved to a new location. Now the orders are chuted down to the truck, thus eliminating any need for the driver to leave his truck and go to the small parts stock for short lengths, elbows, joints, and so on. In a number of other supply yards of contractors who were visited during the survey, the habitual use of large city maps placed outside the office helped to save time by aiding drivers to get started with the least loss of time in planning their routes; and the use of bulletin boards for special memoranda and notices assisted in saving the time of the dispatcher, who otherwise would have to speak to each driver personally.

Saving Time on the Road

After the truck has left its loading point, saving time in getting to the job—or in making the round trip between the job and the loading or unloading point—depends on the driver's knowledge of the route, the condition of the route, and his skill in driving.

It may also depend, however, upon the choice of the route itself. This is especially true on any job that involves placing a fleet of trucks on an established route for a considerable length of time, as in removing excavated material or in bringing supplies to a road-building crew. In all such cases, when the



We manufacture a full line of Tar and Asphalt Kettles, Oil Burning Kettles, Pouring Pots, Torches, Hand Spraying Attachments, etc. Send for our "Blue Book" illustrating our complete line.

CONNERLY'S

Style "J" Oil Burning Kettle will guard any highway with economy and efficiency. Something easy to handle and quick to heat. Equipped with standard roller bearings, springs, improved oil burner and rubber tired wheels and heat guards if desired. In Connerly's Tar and Asphalt Heaters, contractors, town and city officials will find the very highest development of superior workmanship and design. Kettles are made in twenty styles and sizes, in capacities of 10 to 1000 gallons.

CONNERLY & CO., Inc.

3900 N. SECOND ST., PHILADELPHIA, PA.

ASPHALT PLANTS

PORTABLE,
STATIONARY, RAILROAD,
SAND DRYERS

Either Direct Heat or Internal Flame

The

J. D. FARASEY MFG. CO.
CLEVELAND, OHIO



DAVENPORT LOCO. AND MFG. CORPORATION, DAVENPORT, IOWA
Licensed Manuf'r for Wisc., Mich., Ill., Ind. and states west of the Miss. River

HEADLEY EMULSIFIED ASPHALTS

GRADES

No. 1

SUMMER MATERIAL

Road and Highway Construction and Maintenance
Railroad Crossings and Platforms

VIAFALT

WINTER MATERIAL

Road and Highway Construction and Maintenance
Railroad Crossings and Platforms

No. 10

Soft and Tacky Finish

ALL YEAR MATERIAL

Mastic Flooring and Concrete Patchwork
Unexposed Waterproofing and Damp-proofing

No. 11

Hard Non-Tacky Finish

ALL YEAR MATERIAL

Exposed Protective Coatings of all sorts at all times
Specifications on Request

OTHER GRADES FOR SPECIAL PURPOSES

PRACTICAL

DURABLE ECONOMICAL

SOLVE YOUR PROBLEMS

with

EMULSIFIED ASPHALTS

No Heating

No Solvents

IDEAL

COLD-METHOD APPLICATIONS

PAVING USES

COLD PATCHING

RESURFACING

WATERPROOFING USES

ROOFING

DAMP-PROOFING

PROTECTIVE COATINGS FOR

METAL AND MASONRY STRUCTURES

Literature on request.

Headley Emulsified Products Co.

Philadelphia, Pa.

HOTEL BRISTOL

• 129 WEST 48th STREET •
NEW YORK

Most conveniently located—only a few minutes walk to all shopping and amusement centers—yet quiet

Famous Table d'Hôte Restaurants
Luncheon 50c
Dinner \$1.00

Also A La Carte Service

Room, Single, \$2⁰⁰

Double \$3⁰⁰ Per Day

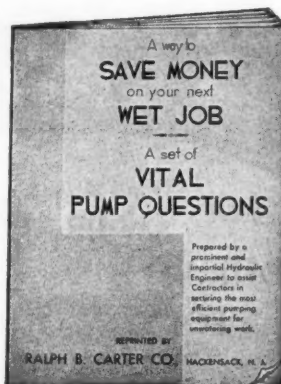
WITH

Bath, Single, \$2⁵⁰

Double \$3⁵⁰ Per Day



A HUMDINGER ANSWER TO EVERY PUMP PROBLEM



Whether it is open excavation, well-point, sewage, pier hole or trench, this little booklet will save you many pump dollars on your next contract.

Send for it today
USE THIS COUPON

RALPH B. CARTER CO.
192 Atlantic St.
Hackensack, N. J.

Please Send me booklet, "A way to SAVE MONEY on your next WET JOB"

NAME

ADDRESS

CITY STATE

When writing, please mention PUBLIC WORKS

trucks will travel the same route regularly, the selection of the route becomes a matter of first importance.

The commonest error—when two or more routes to and from a job are available—is to assume the shortest route is necessarily the best. But in more than one instance, a slightly longer route offering better road conditions, fewer stops, or fewer and lower grades, may prove the speedier. Thus the selection of an established route for a fleet operation may require more than mere study of comparative mileage. The one sure test, of course, is to make trial runs with loaded trucks over the alternative routes. A saving of five minutes a trip, on each truck, will mount into a considerable gain on any job of fairly large size, and may reduce costs in several ways:

—By providing quicker delivery with fewer waits on the job.

—By increasing the daily tonnage of each truck

—By enabling the operator to haul the same or larger tonnage with a smaller fleet.

Five Rules for the Driver.—In any case, on all

types of work, it is seldom wise to leave the actual routing to the judgment of the driver. Far too often the average driver thinks that as long as he keeps moving along at a fair speed he is doing his part. A few blocks one way or the other may not seem important. But every truck superintendent knows that waste mileage—unless counter-balanced by a gain in speed—will be reflected in extra consumption of gas and oil, extra wear on tires and truck, and an appalling loss of time that should be spent productively.

For that reason, drivers should be given five fundamental rules:

- 1 Follow the route prescribed by the office
- 2 Maintain consistently the maximum safe speed allowed for the truck
- 3 Report promptly any delays or breakdowns
- 4 On poor roads, don't take chances on mudholes, rough spots, and railroad tracks
- 5 Don't take chances on accidents. The safe way is the quickest way.

Special attention, of course, should be given to reporting breakdowns and delays immediately. If a driver sees that a delay is likely to be longer than a few minutes he should phone in promptly so that the office can provide another truck.

The driver can make or break a time schedule. Careful instructions are the best insurance against losses on the route.

Preventing Delays at the Unloading Point

In contracting, the most serious delays in truck operation are usually those which occur at the point of actual delivery. Often, therefore, time saved at this point will show up as the greatest gain in profits, both by reducing lost time on the job itself and also by putting the truck operation on a sounder basis.

How to save time in unloading is thus a vital question for the contractor who operates his own trucks. And even the general contractor who owns few trucks will usually find it profitable, in the long run, to cooperate with sub-contractors and supply houses by helping them to reduce or eliminate needless delays in unloading.

Some practical ways to save time in unloading are shown in Fig. 4.

This is the first of a series of articles showing the way to more profitable truck operation. The next will appear in the June issue.—Ed.

Principles of Design of Steel Highway Bridges

(Continued from page 26)

high water, the esthetic requirements as suggested by the location, the length of the bridge, the floor material, maintenance possibilities, erection difficulties, kind of stream (such as dredge ditch or natural channel), skew angle, if any, conditions affecting transportation, cost, and the time element.

The weight of maximum loads will affect the selection of the strength of the structure, while the frequency with which the bridge is used by traffic will affect the selection of floor materials and roadway width.

The difference between the elevation of the roadway and that of high water may decide whether to adopt a deck structure or through structure. We should endeavor to adapt the superstructure to the natural surroundings in so far as possible; such as encasing steel in concrete or using a masonry arch. The overall length of the bridge will generally determine the number and location of spans, provided the main water channel is not in an odd location. The position of railroads and streets influence the span lengths of structures passing over these. Selection of the floor material sometimes has a direct bearing upon type of superstructure.

Steel which is exposed to the elements requires periodic maintenance, and the difficulty and cost of this should be reduced to a minimum by correct design, fabrication and erection. If hanging scaffolds will be required for maintenance painting, we may be sure that the structure will not be painted more frequently than the law requires. Efforts should be made by the designer to minimize construction difficulties such as high false work framing, driving piles in swift currents, location of sills on rock beds, settlement of piling through rubble fills, continued and frequent high-water stages of the stream, driftwood, scarcity of good false-work timbers, soft and unstable stream beds, and various other items.

The same type of superstructure would not be used over a dredged ditch as would be used over a natural channel. If a truss bridge must be skewed, the amount of skew should coincide with the panel point distance, and the location of stiffener angles on plate girders is often determined by the skew angle, and it should be remembered that the transfer of wind stresses to the abutments is not as direct in a skewed structure as in a square one. Transportation facilities may be such as to make it impracticable to use a plate girder. The time element enters into consideration in some cases, and some types of superstructure lend themselves to more rapid construction than others.

In any steel superstructure, regardless of the types, expansion and contraction must be taken care of, and the protection of roller nests or shoes for rockers, and the camber of the structure as a whole, must be considered. Roller nests are generally used to transmit the bearing to the abutments for structures of about 150-foot spans and over. The use of rockers for expansion ends is economical for spans of about 80 feet to 150 feet. Plain bearing plates for expansion ends may be used for spans of less than 80 feet, in which type pins are not used in the end channel points. The roller nests may consist of segmental or complete rollers; in any event they should be large enough and held in place and well protected from exterior influence

The "Domestic" Triplex Road Pump Is the Contractor's Friend



"Domestic" Giant Triplex
500 lbs. Pressure—Force Pump Unit

This "Domestic" Triplex Pump has among its many superior features:

- Abrasive-Resisting, Removable Cylinder Linings.
- Hydraulic, pressure expanding Plunger Packing.
- Herringbone cut steel, self-centering Gears.
- Ball Bearings.
- 80 to 100 gallons per minute capacity.
- 500 lbs. pressure.—40 hp. Engine.

THE GREATEST ROAD PUMP VALUE ON THE MARKET

Write us today for Bulletin F

DOMESTIC ENGINE & PUMP CO.,
MANUFACTURERS
SHIPPENSBURG, PA.

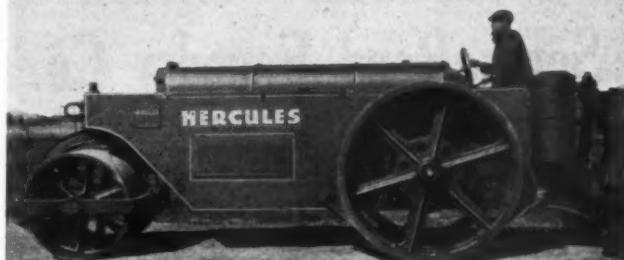
Distributors in all principal cities throughout the United States

HERCULES ROLLERS

ALWAYS ON THE BIGGEST ROAD JOBS

Costs on road jobs occupy an importance greater than ever. Hercules rollers enable the roller part of the job to be finished more speedily—at less cost (and with less maintenance) than has ever been known before—that is the evidence of Highway engineers and contractors who use them on the toughest jobs—Superseding ordinary rollers—Hercules rollers make available to the user—speed—power—flexibility and dependability adding daily to their popularity. A complete range of sizes from six to fifteen tons.

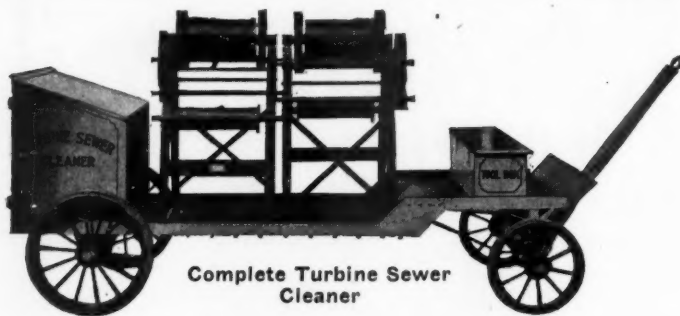
Write or Wire for New Catalog



SOLD ONLY THROUGH DISTRIBUTORS

THE HERCULES COMPANY—MARION, OHIO

When writing, please mention PUBLIC WORKS



Complete Turbine Sewer
Cleaner

Self Propelling Ferret Turbines, Windlasses
Adjustable Turbine Sewer Cleaners
Sewer Braces (Cable Guides)
Drag Type Sewer Cleaners
Five Types of Sewer Rods
Sewer Cables
Conduit Rods

Send for catalog and prices

TURBINE SEWER MACHINE COMPANY

5210 W. State Street

Milwaukee, Wisconsin

Water Filters and Filtration Plant Equipment

for Domestic and Industrial Service

**SWIMMING POOL FILTERS AND RECIRCULATING
PLANTS**

**EQUIPMENT FOR SEWAGE TREATMENT PLANTS
AND PUMPING STATIONS**

We serve as skilled contractors to furnish and install the complete equipment, piping, etc., in all forms of water and sewage plants.

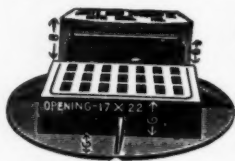
ROBERTS FILTER MFG. COMPANY
 640 COLUMBIA AVE. DARBY, PENNA.

South Bend Foundry Co.

SOUTH BEND, INDIANA

Adjustable Curb Inlet

All Kinds of



**Write For Catalog
AND PRICES**

**Gray Iron Castings
Patent Chilled
Manhole Covers**

**Made in 250, 300, 350 and 400,
470, 490 lbs. Weights**

When writing, please mention PUBLIC WORKS

so as to permit the proper performance of their function.

The number of spans should not be made greater than is necessary to reduce to a minimum the overall cost of the bridge, including the foundation. If the bridge is located over a navigable stream, the regulations of the U. S. War Department may influence the number and length of spans.

The impact to which a structure is subjected is an important consideration in the design; the smoother the approach to the structure and the wearing surface of the floor, the less will be the impact the structure receives. Traffic passing from a concrete road slab to a concrete floor slab at the same plane causes little impact to the superstructure; but entering on to a bridge from a gravel road, the floor slab may receive considerable impact. It is therefore desirable to provide a solid pavement level with the floor of the bridge for a few feet back from the abutment face.

In a steel superstructure a camber should be provided for. No camber can be placed in a span consisting of rolled beams, but the optical illusion of sag in a perfectly level span may be prevented by the use of a properly proportioned concrete curb and handrail.

The author recommends increased use of the so-called cement gun in the application of a coat of encasing mortar about steel members such as plate girders and rolled beams.

(To be continued)

Removing Sludge From Drying Beds

At Worcester, Mass., dried sludge was removed from the beds last year partly by forking into carts by hand, and partly by use of a Barber-Greene loader. The total amount removed by forking was 6,756 cu. yds., and the average cost of this was 53.6 cts. per cubic yard, of which 39% was for teaming. The remainder, or 13,122 cu. yds. was removed by the loader. Of this, 2,914 cu. yds. was special work which is valueless for comparison. The other 10,208 cu. yds. averaged 55.3 cts. per cu. yd., of which 67% was for teaming. To this should be added 2 cts. for gasoline, oil and grease, the department estimates. Deducting the teaming in each case, and adding the 2 cts. in the latter, we have 22 cts. per cu. yd. for forking and 20¼ cts. by the loader.

Concerning the cost by the loader, John H. Brooks, Jr., superintendent of sewers, reports: "Minor repairs of the loader are almost negligible when considering cubic yard cost. Annual overhauling of the loader varies in cost and would average at least an additional two cents per cubic yard of material handled. No attempt has been made to estimate the loader depreciation and utilize a cubic yard cost figure. The machine has been used five seasons, handling from 13,000 to 15,000 cubic yards of dried sludge each season."

In using the loader, sand is unavoidably removed from the bed and carried to the dump, increasing the amount of material to be hauled; while sand will need to be replaced on those beds where the loader is used. On the other hand, there is no question that the dump is in better condition because of the sand mixed with the sludge, which facilitates travel of the sludge wagons over the dump.

NEWS OF THE DISTRIBUTORS

Bay City Shovels, Inc., Bay City, Mich., have removed their eastern office from 302 Broadway, New York, to 9 Westfield ave., Roselle Park, N. J. Their eastern warehouse is located at Roselle, and the change will facilitate service to the trade.

The Cement Lined Pipe Co. announce the removal of their plant from 591 Washington St. to larger and more modern quarters in a separate building at 93 Brookline St., Lynn, Mass.

J. W. Howard, Newark, N. J., has incorporated his inspection and laboratory work, taking into the firm a number of his associates. The new firm is the Howard Inspecting and Testing Laboratory, Inc.

The Truscon Steel Company announces the appointment of Clark P. Pond as vice president of engineering and sales, effective February, 1931. Mr. Pond was formerly connected in a similar capacity with the David Lupton's Sons Company, and is widely known in the building field.

The National Lime Association, 927 Fifteenth Street, N. W., Washington, D. C., announces the appointment of Lee S. Trainor as chief engineer, Construction Division.

R. E. Brooks Co., 50 Church Street, New York, N. Y., have been appointed distributor for Monarch Tractors in the New York territory.

The Joseph G. Pollard Co., Inc., Brooklyn, N. Y., manufacturers of pipe line equipment for water and gas companies, have opened a branch office and warehouse at 1749 East Lake St., Chicago, Ill. W. A. Start, for several years with the Neptune Meter Co., and later with the A. P. Smith Mfg. Co., covering the central west and south-western states will be in charge. A complete stock of pipe line equipment will be carried at the Chicago warehouse, thereby facilitating prompt shipment in the territory west of Ohio.

The McWane Cast Iron Pipe Company, of Birmingham, removed its eastern sales offices from Philadelphia to New York, effective April 15th. The new offices are in Suite 1408 Lord Court Building, at 40 Exchange Place, New York; and will continue in charge of Porter W. Allen, who has been Eastern sales manager at Philadelphia for the past several years. While the removal is stated to be due to the growing importance of New York as headquarters for the larger buyers of water works and gas materials, it will also enable the company to maintain a closer touch with its growing New England clientele, without lessening its long-established and close contacts with similar interests in the Philadelphia area.

The Trackson Company, Milwaukee, Wis., announces the appointment of Dow-Potter Company, Inc., Erie County Bank Bldg., Buffalo, New York, as a new distributor for Trackson Tractor Equipment. This distributor will handle the complete Trackson line of crawlers, shovels, hoists, cranes, bulldozers, etc., as well as a stock of repair and replacement parts for these machines.

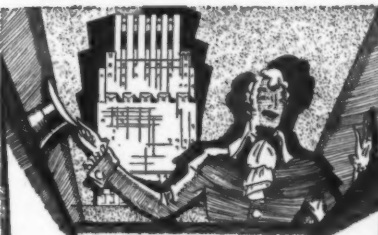
Bay City Shovels, Inc., Bay City, Michigan, manufacturers of six different types of convertible power shovels, cranes and excavators have completed arrangements for the manufacture of their complete line in Canada. Arrangements have been made with the John Inglis Company, Ltd. of Toronto, to manufacture various Bay City machines in Toronto.

The Trackson Co., Milwaukee, Wis., announces the appointment of W. W. Williams Co., 835 W. Goodale St., Columbus, Ohio, as a new distributor for Trackson Tractor Equipment. This distributor will handle the complete Trackson line of Crawlers, Shovels, Hoists, Cranes, Bulldozers, etc., as well as a stock of repair and replacement parts for these machines.

The Pennsylvania-Dixie Cement Corporation, New York City, announces the appointment of O. C. Hunt as sales manager in charge of the territory served by its Des Moines plant. His headquarters will be in the Insurance Exchange Bldg., Des Moines, Iowa. R. J. Hild continues as district sales manager.

The new Kansas City offices of the McWane Cast Iron Pipe Company are announced as having been opened March 1st, at 1006 Grand Avenue in that city, with C. H. Allen in charge. Mr. Allen has been connected for a number of years with the Chicago sales office of the company, and his promotion to managership of this, the eleventh district sales office of the McWane-Pacific States Cast Iron Pipe interests, will bring him in closer contact with Kansas, Nebraska, Missouri, and northern Oklahoma. The new office is opened on the eighth anniversary of the completion of the first unit of the original McWane pipe foundries in Birmingham, and is now a part of a pipe-making organization with large foundries in Birmingham, Alabama, and Provo, Utah, and with sales offices in key cities throughout the nation.

At the annual meeting of the stockholders of the Monighan Manufacturing Corporation, manufacturers of walking dragline excavators, the stockholders voted to change the name of the company to Bucyrus-Monighan Company. This action has been approved by the Board of Directors of the Bucyrus-Erie



There's an air of hospitality that you'll like

AT THE HOTEL
PICCADILLY
227 WEST 45th STREET
• AT BROADWAY •
NEW YORK

ADJACENT TO
EVERY ACTIVITY
600 BRIGHT-
SUNLIT ROOMS
EACH WITH BATH
ELECTRIC FAN
ICE WATER
SINGLE ROOM
AND BATH
\$ 3 00
DOUBLE ROOM
AND BATH
\$ 4 50
EXCEPTIONAL
RESTAURANT
• AND
GRILLE
WIRE AT OUR
EXPENSE FOR
RESERVATIONS
F. D. SOFIELD
MANAGING DIR.

Company. The Bucyrus-Monighan Company will operate as a separate organization exactly as the Monighan Manufacturing Corporation did in the past except that sales will be handled by the Bucyrus-Erie sales organization. The following directors were elected: Messrs. W. W. Coleman, E. K. Swigart, W. M. Bager and G. A. Morison of Milwaukee and Messrs. O. J. Martinson, W. T. Brennen and T. H. McGowen, of Chicago. W. W. Coleman was elected chairman of the Board of Directors and G. A. Morison vice chairman, in addition to which the old officers were reelected as follows: O. J. Martinson, president; W. T. Brennen, vice president and treasurer, and H. W. Voss, secretary.

SAVE MONEY!

LET US DOCTOR YOUR METER TROUBLES

On account of our low overhead expense, we are able to save you money on your meter repairs.

PACK ALL MAKES IN ONE BOX
AND SEND TO

HYDRAULIC EQUIPMENT CO.
Formerly READING METER REPAIR CO.
522 Court St. Reading, Pa.



WATER

—is purest and safest when taken from

Drilled or Driven Wells

We drill or drive them anywhere—any size—to any depth. Also air holes for mines.

Many years of experience — Hundreds of satisfied customers.

Write us regarding your water problem. Estimates are given cheerfully and entail no obligation.

ARTESIAN WELL and SUPPLY CO.
PROVIDENCE, R. I.



WRITE
FOR
ILLUSTRATED
BOOKLET



DRAIN TILE

Round and Hexagon

AND OTHER HEAVY
CLAY PRODUCTS

THE PROGRESSIVE CLAY CO.

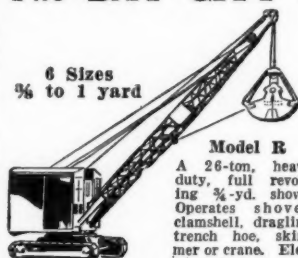
Pennsylvania Bldg.
NEW YORK, N. Y.

Bulletin Bldg.
PHILA., PA.

Gurney Bldg.
SYRACUSE, N. Y.

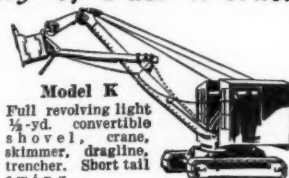
The BAY CITY Family of Fast Workers

6 Sizes
¾ to 1 yard



Model R

A 26-ton, heavy-duty, full revolving ¾-yd. shovel. Operates shovel, clamshell, dragline, trench hoe, skimmer or crane. Electric starter.



Model K

Full revolving light ½-yd. convertible shovel, crane, skimmer, dragline, trencher. Short tail swing.



Tractor Shovel

Recognized leader in its field. Operates shovel, trench hoe, clamshell, dragline, backfiller or crane boom. Weighs 10 tons.

Bay City Shovels, Inc.

Convertible Power Shovels

Bay City, Mich., U. S. A.

FOR
JOINTING BELL AND SPIGOT WATER MAINS



USE

MINERALEAD

Impervious to moisture

No caulking

Easy melting

Rapid pouring

Absolute uniformity

Less initial leakage

Easy handling—ingot form

A saving in cost of material and labor

Deep bell holes unnecessary

Write for Catalogue

THE ATLAS MINERAL PRODUCTS COMPANY
of Pennsylvania
MERTZTOWN PENNSYLVANIA
ESTABLISHED 1892

makes permanent water-tight, acid-proof joints and saves money, time and labor

"EXXLCELL"

Sewer Pipe Joint Compound

TESTED in the mass during manufacture and rechecked in the laboratory to insure uniformity of every batch "exXLcell" is the result of long experience and modern methods and machinery. It is watertight, heat tight and acid-proof.

ExXLcell melts freely at moderate kettle heat. Cools rapidly. Sets in a few minutes after joint is sealed. Pliable at all temperatures. Will not run in summer or crack at zero. Stands tremendous heat without damage. Write for catalog.

Cochrane Chemical Co.

Industrial Paints, Waterproofing and Insulating Compounds
Expansion Joint Compounds, Cements
432 Danforth Ave., Jersey City, N. J.

Materials and Equipment Catalogs

Low Cost Roads.—Tarvia low cost roads are covered in a well illustrated booklet issued by the Barrett Co., New York. Among the headings are "Straight Surface Treatment," "Mulch Treatment," "Blotter Treatments."

Tarvia Re-Tread.—An 8-page folder issued by the Barrett Co., New York, which answers some important questions concerning this type of road material. Interesting, too, and well illustrated.

Armco Metalcurb. A new pamphlet on Armco Metalcurb has been issued by the American Rolling Mill Co., Middletown, O., to give more complete information about this new product, which is designed to reduce road construction and maintenance costs.

Leaning Wheel Graders.—Caterpillar Tractor Co. has brought out a new book describing the Caterpillar "30" Leaning Wheel Grader.

Metal Protective Finishes.—Sherwin-Williams Co., Cleveland, O., have issued a valuable booklet covering Metal Protective Finishes. In the 28 pages of this booklet is included information covering nearly all metal surfaces.

Road Graders.—Austin - Western Road Machinery Co., Chicago, Ill., have issued a new bulletin covering their No. 37 Road Grader.

Shovels and Cranes.—Speeder Machinery Co., Cedar Rapids, Ia., have published new catalogs covering their models B-3½-yard, Whirlwind ¾-yard, and Model 90 1¼-yard machines. These give full technical information and illustrate attractively these machines engaged in various kinds of work.

Hardinge Sanitation Equipment.—The Hardinge Co., York, Pa., have issued a booklet covering clarifiers, digester tank mechanisms, sludge pumps, aerators, coagulation units and Ruggles-Coles dryers.

Central Station Equipment.—The Atlas Car and Mfg. Co., Cleveland, O., has published bulletin No. 1227 covering equipment for central station and industrial power plants.

Modern Street Lighting. Bringing Cities Out of the Twilight Zone is the title of a new street lighting publication issued by the Westinghouse Lamp Company and the Westinghouse Electric and Manufacturing Company. Its thirty-two pages are devoted to a discussion of modern street lighting by L. A. S. Wood, Manager, Exterior Lighting Section, Westinghouse Electric and Manufacturing Company, presenting reasons and methods for providing well-illuminated streets. It is profusely illustrated with photographs of street lighting installations and of

various Westinghouse street lighting equipment. The publication is identified as No. A-1206, and has been assigned A.I.A. File No. 31-M-11.

Hydrants. The Mathews Modernized Hydrant is described as the most important advancement in fire hydrant design in sixty-four years in a folder recently issued by R. D. Wood & Co., Philadelphia, Pa. You can get a copy from PUBLIC WORKS.

Use the Coupon on Page 95 if You Want Any of These.

Transits and Levels.—Warren-Knight Co., 136 N. 12th St., Philadelphia, Pa., have issued a catalog describing transits and levels of a very high character, and also the new Warren-Knight Transit-Level, described in the April issue of PUBLIC WORKS.

Maintenance Kettles.—Littleford Bros., 457 E. Pearl St., Cincinnati, Ohio, have issued an illustrated folder describing their new high-speed maintenance kettle.

Dowflake.—The Dow Chemical Co., Midland, Mich., have issued a new folder with some snappy spring poetry discussing the value of calcium chloride for gravel roads.

Wheeled Scoops.—W. A. Riddell Co., Bucyrus, O., have compiled all their literature on wheeled scoops into a portfolio, which contains a whole lot of valuable information for dirt movers.

Graders and Crawlers.—W. A. Riddell Co., Bucyrus, O., will send on request a portfolio of literature and data covering power graders and rear-type crawlers.

Austin Motor Sweepers.—The Austin Motor Pick-Up Sweeper is described in detail in a 22-page illustrated catalog, which will be sent free on request to Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago, Ill.

Hoists and "Hysters."—The Willamette-Ersted Co., Portland, Ore., has published a valuable data book containing 100 pages and many illustrations. It gives condensed information about their equipment and its mechanical details and shows engineering drawings and photographs showing applications and efficiency. This equipment is for use with Caterpillar Tractors.

Electric CO₂ Meters.—The Brown Instrument Co., Philadelphia, Pa., has issued catalog No. 3004, describing indicating and recording electric meters for Carbon Dioxide. 32 pages, 36 illustrations.

Porous Plates and Tubes.—The Norton Co., Worcester, Mass., has published a 52-page booklet on their porous plates, tubes and diaphragms, which contains much valuable information for engineers interested in activated sludge treatment processes.

Controls.—The Brown Instrument Company, Philadelphia, Pa., has just published a new catalog containing the latest data on Brown Automatic Controls for temperatures, pressures, flows, liquid levels, and other vital process operating factors. Tells how automatic controls help quality, workers, management, cost and sales. Shows how temperature controls can be applied to all types of furnaces, kilns, ovens, kettles, etc., whether electric, gas-fired, oil-fired, coal-fired or heated by waste gases, steam or other means. The book contains 48 pages and 46 illustrations. A copy will be sent promptly to any industrial executive requesting same from The Brown Instrument Company, Philadelphia, Pa. Persons writing for a copy of this catalog should ask for Catalog No. 8008.

Elevating Grader.—The Austin Contractors' Special Elevating Grader, with 48-inch, engine driven carrier and roller bearings, is described in Bulletin No. 1213, published by the Austin-Western Road Machinery Co., Chicago, Ill.

Diesel Engines.—Vertical solid injection diesel engines are described and information given concerning their economy, reliability and suitability for different types of work in a book of 40 pages published by I. P. Morris & De La Vergne, Inc., Philadelphia, Pa. The booklet is beautifully printed and contains many illustrations, charts, etc.

Dirtmovers. A new booklet featuring Ateco Hydraulic Dirtmovers has just been issued by the American Tractor Equipment Co., of Oakland, California, and Peoria, Illinois. It tells a tale graphically and pictorially of wider, safer and smoother roads, of smoother landing fields for airports, of lower costs on big and little excavation jobs, and of Ateco's accurate control, careful design and sturdy construction.

Copies of this Bulletin No. 131 may be obtained from the factory either in Oakland or Peoria, from any "Caterpillar" Dealer, or from PUBLIC WORKS.

Fire Clay Refractories.—This film is three reels in length and requires about forty-five minutes to project. It is available in the 35mm. and 16mm. size for stationary or portable projectors. Copies are distributed by the U. S. Department of Commerce Bureau of Mines, Pittsburgh, Pa., under the motion picture subject No. 97, "Story of Fire Clay Refractories," no rental.

American Road Builders' Association

The annual meeting of the American Road Builders' Association will be held in Washington, D. C., on May 15. Other meetings of old and incoming boards of directors of the national association and the various divisions will be held on May 14 and 16.

Plans will be perfected at these meetings for the work of the coming year. Among the subjects to be discussed are the appointment of joint cooperating committees with the American Association of State Highway Officials and the Highway Research Board, and the chairmen of more than a score of committees that will engage in the investigative work of the year.

Officers for the coming year are:

President: W. R. Smith, Lane Construction Co., Meriden, Conn. **Vice Presidents:** Samuel Eckles, chief engineer, Pennsylvania Department of Highways, Harrisburg, Pa.; H. G. Shirley, state highway commissioner, Richmond, Va.; S. F. Beatty, president, the Austin-Western Road Machinery Co., Chicago, Ill.; Stanley Abel, board of supervisors, Kern county, California; **Treasurer:** J. H. MacDonald, consulting road and paving expert, New Haven, Conn.

Directors: H. K. Bishop, chief, Division of Construction, U. S. Bureau of Public Roads, Washington, D. C.; R. B. Brooks, director of streets and sewers, St. Louis, Mo.; P. L. Griffiths, vice president, American Tar Products Co., Pittsburgh, Pa.; A. L. Grover, secretary, New Jersey Highway Department, Trenton, N. J.; Richard Hopkins, contractor, Troy, N. Y.; J. E. Pennybacker, managing director, the Asphalt Institute, New York, N. Y.; H. C. Whitehurst, engineer of highways, District of Columbia, Washington, D. C.

City Officials' Division:

President: G. B. Sowers, commissioner of engineering and construction, Cleveland, O. **Vice Presidents:** A. T. Rhodes, superintendent of streets and sewers, Leominster, Mass.; W. E. Shedd, city engineer, Jacksonville,

NOTES of ENGINEERING SOCIETIES

Fla.; R. B. Brooks, director of streets and sewers, St. Louis, Mo.; O. Laurgaard, city engineer, Portland, Ore.

Directors: D. L. Erickson, city engineer, Lincoln, Nebr.; L. W. Herzog, commissioner of public works, Albany, N. Y.; H. W. Kueffner, director of public works, Durham, N. C.; H. C. McClure, director of public works, Flint, Mich.; G. E. Stanley, city engineer and superintendent of streets, Burlington, Vt.; J. M. Tippee, city engineer, Des Moines, Ia.; Bryson Valas, city engineer, New Orleans, La.

County Highway Officials' Division:

President: Otto Hess, engineer-manager, Kent County Road Commission, Grand Rapids, Mich. **Vice Presidents:** H. B. Keasbey, county engineer, Salem county, Salem, N. J.; W. O. Washington, county engineer, Cameron county, Brownsville, Tex.; H. G. Sours, county engineer, Summit county, Akron, O.; G. W. Jones, county superintendent of highways, Los Angeles county, Cal.

Directors: W. W. Brandon, county commissioner, Tuscaloosa county, Tuscaloosa, Ala.; Charles Browne, chief engineer, Orange county, Orlando, Fla.; E. L. Gates, superintendent of highways, DuPage county, Wheaton, Ill.; E. A. Griffith, chief engineer of roads, Allegheny county, Pittsburgh, Pa.; L. O. Marden, county engineer, Worcester county, Worcester, Mass.; J. W. Mavity, county engineer, Harvey county, Newton, Kans.; J. C. McLean, county engineer, Woodbury county, Sioux City, Ia.



A 2-ton Dodge Truck used by Bureau County, Ill., Highway Department. It is equipped with a 500-gallon Columbian tank and a Willett Spring Road Scraper. In the winter a snow plow is mounted on the front.

Prize Contest at the A. W. W. A. Convention

The Exhibit Committee of the Water Works Manufacturers Association is offering a suitable prize to be awarded to the manufacturer who has the most instructive exhibit at the convention this year.

The manufacturers are inviting every A. W. W. A. member to vote his preference as to the most instructive exhibit and the prize will be awarded the exhibitor receiving the largest number of votes. Ballots and ballot boxes will be provided in the Exhibit Hall.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of PUBLIC WORKS published monthly at New York, N. Y., for April 1, 1931.
State of New York
County of New York ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared J. T. Morris, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the PUBLIC WORKS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Public Works Journal Corp., 310 East 45th St., New York, N. Y.; Editor, A. Prescott Folwell, 310 East 45th St., New York, N. Y.; Managing Editor, none; Business Manager, J. T. Morris, 310 East 45th St., New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the name and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

Public Works Journal Corp., 310 East 45th St., New York, N. Y.; J. T. Morris, 310 East 45th St., New York, N. Y.; W. A. Hardenbergh, 310 East 45th St., New York, N. Y.; A. Prescott Folwell, 310 East 45th St., New York, N. Y.; S. N. Hume, 2534 Kemper Road, Cleveland, Ohio; F. Clay Viguerie, 310 East 45th St., New York, N. Y.; Croxton Morris, 310 East 45th St., New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding one per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

Sweetland Publishing Co., 521 Fifth Ave., New York, N. Y.; (Stockholders unknown).

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is — (This information is required from daily publications only.)

J. T. MORRIS,

(Signature of business manager)

Sworn to and subscribed before me this 30th day of March, 1931.

(Seal) CROXTON MORRIS,
Notary Public, Westchester County, N. Y., Cert. filed in N. Y. Co. No. 317, Reg. No. 3M225. Commission expires March 30th, 1933.

Free Industrial Literature

Check up now and see if you need any of the bulletins described on these pages. They will be sent free. Just fill in the form at the bottom of the page or write to the company direct, giving number of booklet and mentioning
PUBLIC WORKS

Construction Methods and Equipment

Accessories, Motor Truck

1. Truck accessories—winches, power take-offs, derricks, special bodies, earth boring machines, and trailers of all capacities are described in a series of folders issued by the Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Asphalt Heaters

8. A 54-page booklet issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates oil, wood and coal burning asphalt and tar kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools and their use in road construction.

9. "Hotstuf," the master oil burning heater, is the only heater with patented elevated melting chamber for Asphalt. Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Described in illustrated manual No. 11—Mohawk Asphalt Heater Co., 94 Weaver St., Schenectady, N. Y.

Asphalt Plants

10. J. D. Farasey Mfg. Company, Cleveland, Ohio, issue a booklet for use and specifications for Farasey Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours. Cheap to operate.

Asphalt Rollers

12. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Issued by the Erie Machine Shops, Erie, Pa.

Chip Spreaders

25. The Universal Road Machinery Company of Kingston, N. Y., have issued a booklet describing their Reliance Chip Spreader, a special trailer, operating in the reverse direction, designed for resurfacing bituminous highways. Spreads to a width of 8' to any desired thickness.

Clamshell Buckets

27. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Clamshell Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Clamshell Buckets will also be furnished on request.



Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully the subjects suggested by its title. A well-illustrated and instructive volume.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Published by the Solvay Sales Corp., 61 Broadway, New York, N. Y.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Building Construction, Bridges, Culverts and Concrete Products." Concise practical data, embodies latest information on subject. Issued by Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Jaeger Concrete Mixers, both Tilting and Non-Tilting types, from 3½ to 84s size, with illustrated descriptions of all types mounting, power and loading equipment—64 pages published by The Jaeger Machine Company, Columbus, Ohio.

Crushers

56. Pioneer Gravel Equipment Manufacturing Company, Minneapolis, Minnesota, publishes complete 80-page manual, showing blue print sketches of set-ups in pit or quarry of the eleven different sizes of Pioneer Crushing Plants.

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Gallon Iron Works & Mfg Co., Gallon, Ohio.

59. A new booklet has just been issued by the Universal Road Machinery Company of Kingston, N. Y., describing their full line of portable and stationary crushing, screening and washing units.

Culverts—Large Diameter

60. Ease and speed of installation, economy, a full-width roadway and durable, maintenance-free service, are listed in the new catalog, "Armco Large Diameter Corrugated Pipe," as the advantages following the use of larger diameter culverts in meeting small bridge requirements. Catalog No. 8 will be sent free on request. Address Armco Culvert Mfrs. Association, Middletown, Ohio.

Drag Lines

61. Write for complete catalog on Pioneer Drag Line. Catalog shows cross section of Drum Unit with full description of Frame, Sheaves, Motor and Bucket.—Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Dump Wagons, Spring Wind-Up

68. Bulletin W-30-J, just issued by Western Wheeled Scraper Company, Aurora, Illinois, illustrates and explains the new

Western Automatic Spring Wind-up with which all Western Crawler dump wagons, either new or in service, can be equipped without requiring any attachment on the tractor. This device makes the employment of a wagon man unnecessary.

Dump Wagons, Steel

70. Steel Dump Bodies and hydraulic hoists for Fords and other small trucks are described and fully illustrated in technical literature published by the Wood Hydraulic Hoist and Body Co., 7924-60 Rlopelle St., Detroit, Mich.

71. "Steel Dump Bodies." Full data on steel dump bodies for every type of hauling proposition and description of special "Self-Dumper Bodies" for road Builders. Wood Hydraulic Hoist and Body Co., 7924-60 Rlopelle St., Detroit, Mich.

Finishing Machine

75. Complete description of Lakewood Finishers, showing use of single and tandem screeds and tamper attachment for high speed production on concrete and bituminous pavements, city streets and highways—33 pages published by The Lakewood Engineering Company, Columbus, Ohio.

Excavating Buckets

80. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Excavating Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Excavating Buckets will also be furnished on request.

Hoists, Truck

85. "Dump Truck Hoist." Double the Truck's value by using power operated Hydraulic Hoists. Catalog of WOOD Hydraulic Hoist and Body Company, Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Hoppers, Measuring

86. The C. S. Johnson Co., Champaign, Ill., publish a booklet which describes the Johnson Demountable Bins and Measuring Hoppers. Data sent on request.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service available from the Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Lanterns and Torches

90. Send for interesting catalog in colors of Dietz Lanterns and Road Torches adapted for night traffic warning on any construction work that obstructs the highways. R. E. Dietz Co., 60 Laight St., New York, N. Y.

Loaders and Unloaders

96. Portable car unloaders save money for the contractor on road and other con-

TEAR OFF AND MAIL THIS FORM FOR INDUSTRIAL LITERATURE

PUBLIC WORKS

310 East 45th Street, New York City.

Gentlemen:

Please send me without obligation the following catalogs listed under INDUSTRIAL LITERATURE SECTION:

(Indicate by Numbers)

Name
5-31

Street Address

City



struction projects. Full information on this and on the Rellance Chip and sand spreader on request. Universal Road Machinery Co., Kingston, N. Y.

97. Link-Belt Company, Philadelphia, describes a line of Portable Loaders and Unloaders in Folders: Nos. 1073 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket Elevators for different classes of work; and No. 1149, the "Grizzly" Crawler Loader for heavy work and large capacities.

Motor Trucks

106. "Operating Trucks Profitably in Contracting"—A 24 page survey with practical data on efficient truck operation and what to consider in selecting new equipment just published by General Motors Truck Company—Pontiac, Mich.

107. "Trucks for Federal, State, County and City Governments," a booklet issued by Dodge Brothers, division of Chrysler Corporation, gives information about company's trucks in municipal, county, state and government activity.

108. Four-wheel-drive trucks to increase the range of truck operation and for economy of operation for use in road building and maintenance, described in a series of new folders just issued by the Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Paving Materials

109. A 36 page booklet with 66 illustrations has just been issued by the Barrett Co. giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. Profusely illustrated with photographs, 24 pages. The Barrett Company, 40 Rector Street, New York.

Plows

112. Plows, Grade Rippers (Scarifiers) and Scrapers are fully illustrated in a new catalogue which will be sent upon request by Wiard Plow Company, Batavia, N. Y. Oldest Plow manufacturers in America.

Power Graders

117. A large wall display piece, No. 3101, printed in three colors and containing a very large illustration of the WARCO Model "E" power grader as well as complete description and working views on center control graders will be sent by the W. A. Riddell Co., of Bucyrus, Ohio, to anyone interested.

Pumps, Contractors'

119. 'Domestic' Contractors' Pumps. Automatic Priming, Ball Bearing Centrifugals 2½" to 6" sizes. 'Giant' Road Pumps, 80 and 100 gallons per minute. Dependable Diaphragm and Plunger Trench Pumps and Hoists. Special Bulletins. Domestic Engine & Pump Co., Shippenburg, Pa.

122. Humdinger contractors' pumps. Diaphragm pumps in both the open discharge and the diaphragm force pump types. Self-priming Centrifugal pump, for automatic continuous prime on suction lifts up to 28'. Are described fully and valuable practical information for contractors is given in special Bulletins #107-A and 1034. Ralph B. Carter Co., 53 Park Place, New York, N. Y.

Road Construction

123. "Road Construction and Maintenance" are covered in a new Cletrac Booklet, which takes up such subjects as modern methods of handling large capacity equipment, tandem equipment, etc. Cleveland Tractor Co., 1932 Euclid Ave., Cleveland, Ohio.

Road Rollers, Scrapers, Graders, etc.

125. Plows, Grade Rippers (Scarifiers) and Scrapers are fully illustrated in a new catalogue which will be sent upon request by Wiard Plow Company, Batavia, N. Y. Oldest Plow manufacturers in America.

quest by Wiard Plow Company, Batavia, N. Y. Oldest Plow manufacturers in America.

126. Illustrated catalogs and descriptive material HERCULES All-steel, 6-cylinder road roller. 60 H.P. Gasoline engine. Sizes 5, 7, 8, 10, 12, and 15 tons. Three speeds forward and backward. Cast Steel rollers. The Hercules Company, Marion, Ohio.

127. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Issued by the Erie Machine Shops, Erie, Pa.

128. A beautiful 32 page book in four colors featuring their entire line of road rollers has been published by the Buffalo-Springfield Roller Co. of Springfield, Ohio. 8½ x 11, leatherette cover, numerous action pictures.

131. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers. The Buffalo-Springfield Roller Company, Springfield, Ohio.

132. "Road Machinery." A sixty-four page data book has been issued by the Austin-Western Road Machinery Company, 400 No. Michigan Ave., Chicago, describing their full line of road building machinery. Included in it are illustrations and descriptions of road graders, 5-foot blade to 12-foot blade; road rollers, steam or gasoline powered, 3 to 15-ton single cylinder to four cylinder. Motor graders, three sizes. Scarifiers. Crushing plant equipment, small road tools. Special bulletins on each separate piece of machinery supplement the general catalog.

133. "Road Rollers." New illustrated booklets covering the entire line of Master 4-Cylinder motor roller, 4-cylinder tandem roller and International motor roller. Gallon Iron Works and Manufacturing Co., Gallon, O.

134. 36-page, illustrated book describing mechanical features of Huber 4-cylinder Motor Roller and its application to many types of road construction and maintenance. Huber Mfg. Company, Marlon, Ohio.

135. Road Machinery Illustrated. New illustrated bulletins on the master Motor Roller, Three-Wheel and Tandem Rollers, Motor Graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and Straight and Leaning Wheel Graders. Gallon Iron Works & Mfg. Co., Gallon, O.

136. Full description of Huber Motor Rollers in sizes from 5 to 15 tons, included in durable 36-page book for use by road contractors and maintenance crews. Huber Mfg. Co., 345 E. Center St., Marlon, Ohio.

Sand and Gravel Washing Plants

139. Up to date information on Portable Sand and Gravel Washing Plants with concrete capacities, ranging from 30 to 100 yards per hour.—Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Screens

140. Full information concerning Shaker and Revolving Screens, Conveyors, Elevators, Bins and Chutes is contained in catalog and special illustrated folders on Pioneer line. Write Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Shovels, Cranes and Excavators

142. The Cranemobile, "successor to Trench Cranes," an adaptation of the crawler mounted Bay City Tractor Shovel is fully described and illustrated in Bulletin C2 just issued by Bay City Shovels, Inc., Bay City, Mich.

145. Catalog K3 just issued, completely describes the light half yard and the full half yard convertible shovel, crane, dragline, trench hoe and skimmer manufactured by Bay City Shovels, Inc., Bay City, Mich. 28 pages, over 50 illustrations, action pictures and charts.

151. The complete line of ½-yd. to

1½-yd. shovels, cranes, draglines, ditchers and skimmers manufactured by the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill., is described in Bulletin 60, which also gives lifting capacities and working ranges for the different sizes and types of these crawling tread machines.

Steel Forms

155. A well illustrated catalog of Steel Forms for concrete road, curb and sidewalk construction is available from The Heltzel Steel Form & Iron Company, Warren, O.

Steel Bins

159. Steel bins and measuring hoppers are included in a fully illustrated catalog of Contractors Equipment issued by The Heltzel Steel Form & Iron Company, Warren, Ohio. Write for your copy.

Steel Posts

160. Steel Posts for all purposes. Sweet's Herculean Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport, Pa.

Tires, Truck and Car

165. Solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Full information and data available from Government Sales Department of the Good-year Tire & Rubber Company, Inc., Akron, Ohio.

Tractors, Crawler

169. Cletrac crawler tractors. Cleveland Tractor Co., 1932 Euclid Ave., Cleveland, O. Bulletin 562 describes their use in roadbuilding and maintenance, earth moving, excavating, grading, snow removal, field work and lumbering. Made in "20," "30," and "40" and "100" sizes.

170. "Roads," a series of five fully illustrated folders, prepared by the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill., shows what Russell graders and "Caterpillar" tractors can do and are doing to build better roads quicker and cheaper.

171. The design, construction, details and complete specifications of the new Ten and Fifteen models "Caterpillar" are given in a booklet recently published by the Caterpillar Tractor Co. of San Leandro, Calif., and Peoria, Ill.

173. Cletrac Crawler Tractors are built in a complete line by The Cleveland Tractor Company, 1932 Euclid Ave., Cleveland, Ohio. Cletracs range in size from the 12 h. p. model to the powerful 100 h. p. tractor.

Tractors, Wheel

175. "Huber Tractors" and "The Huber Motor Rollers." Illustrations of machines in operation and testimonials from users. The Huber Mfg. Co., 345 E. Center St., Marlon, Ohio.

Truck Cranes

182. Full-revolving, gasoline-operated Truck Cranes with a capacity of 7½ tons at a 10 ft. radius, for mounting on a 5-ton or 7½ ton auto-truck, are described in Bulletin 62, issued by the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill.

Truck Hoists

183. "Dump Truck Hoists." Double the Truck's Value by using power operated Hydraulic Hoists. Booklet published by WOOD Hydraulic Hoist and Body Company, 7924 Riopelle St., Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

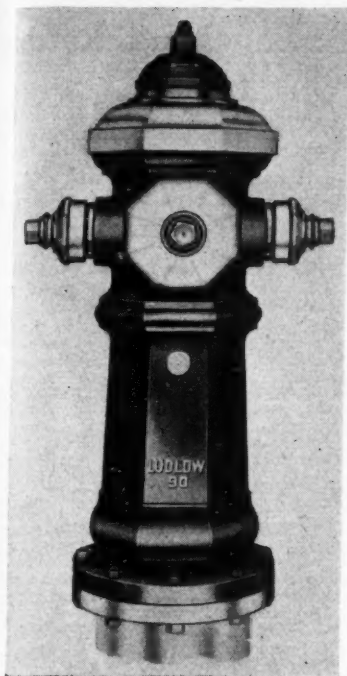
Wheeled Scoops

190. The WARCO wheeled scoops, claimed to offer the most economical handling of earth on short hauls, is fully described and illustrated in Bulletin No. 3102 issued by the W. A. Riddell Co., of Bucyrus, Ohio. Printed in three colors and fully illustrated—will be sent to anyone interested.



SWEET'S
STEEL POSTS
STRONG DURABLE POSTS
for every kind of Fence and Sign Post requirements —
SWEET'S STEEL COMPANY · WILLIAMSPORT, PENNA.

NEWS OF THE WATER WORKS FIELD



The Ludlow Diamond.

Ludlow Diamond Fire Hydrant

The Ludlow Valve Manufacturing Company, Troy, N. Y., has introduced a new fire hydrant known as The Ludlow Diamond.

The octagonal shape offers an important advantage. The eight flat surfaces, especially on the dome and caps, provide eight light-reflecting planes. When the dome and caps are painted with aluminum paint, the hydrant becomes practically self-illuminating, and instantly locates and identifies itself even by day. At night it is easily picked up as these surfaces will reflect any light, even that of a street lamp. It warns motorists to keep away, and when the emergency comes it is located quickly by the headlights.

Pleasing and practical color combinations are easily made, as the design lends itself to decorative effects in black, orange and silver, black, red and silver, or any other combination.

The body is not integral with the barrel, but ends in a flange which is bolted to the barrel flange just above the ground line. The bolt holes are so arranged that the hydrant nozzles can be set in any direction required, without disturbing the hydrant bottom or lead from the main.

It is in replacement work that this feature should be especially valuable. The hydrant body is so designed that any breakage caused by impact with a heavy truck, for instance, will occur just above the flange. By merely releasing 8 bolts here the old body can be removed and a new one substituted in a few minutes time. As most of the damage to hydrants occurs in winter, due to skidding the fact that no digging is required means a saving in time and money, and greater protection.

Certain changes have also been made in the hydrant bottom. This employs

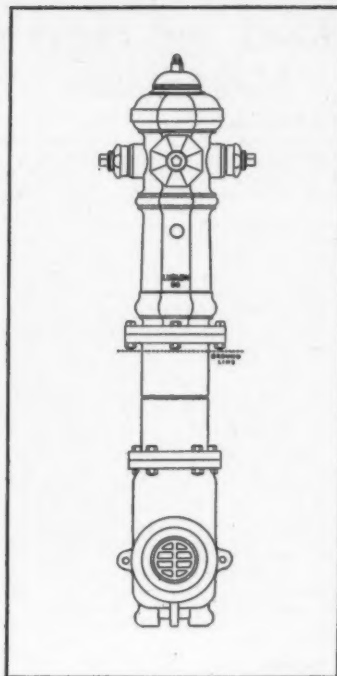
the Ludlow gate valve, the gate being lowered free and forced squarely against its seat by a wedge nut at the back of the gate. Through a few simple improvements in design, the lines of force are now opposed and directed downward, so that once the gate is closed with the drip valve open, it cannot be pulled free, and can be released only by turning the valve stem. Even if the hydrant body is broken the valve will not cause a flood.

Variations in grade can now be handled by selecting the proper length of connecting barrel. Since the hydrant body and bottom are standard for each size, it is merely necessary to stock a few of these in the proper sizes, as the correct depth is taken care of with flanged connecting barrels of suitable length.

The Ludlow Valve Manufacturing Company was founded in 1868. They state that during the last 65 years they have produced more than 8,000,000 valves and hydrants. The Ludlow Diamond Hydrant is fully explained and illustrated in a handsome folder which they will send free to anyone requesting.

Plane Carries H T H for Nicaragua Earthquake Relief

When American Red Cross planes recently rushed emergency supplies to the stricken area in Nicaragua, the chlorine carried was in the highly-concentrated powder form of H T H. The disastrous earthquake which destroyed the city of Managua and its water supply system brought disease in its wake to add to the already heavy toll of lives. Chlorine for sterilizing and disinfecting was urgently needed, together with antitoxin, to avert further tragedy. An appeal sent out to Washington brought quick action.



The Ludlow Diamond.

At 11:30 A. M. on Saturday, April 4th, a rush call for H T H came over the telephone from Government officials at Washington to the Philadelphia Office of The Mathieson Alkali Works. Less than one hour later, at exactly 12:29 P. M., a special truck delivery from the local warehouse was completed at League Island Navy Yard and the shipment of H T H was placed in the waiting Red Cross plane. At 1:30 P. M., with a supply of antitoxin also on board, the plane took off for Nicaragua.

In another recent earthquake disaster, that in New Zealand, H T H also was rushed to the stricken areas and served to check the outbreak of disease through its immediate use for emergency chlorination. Here again its high concentration and easy application were important factors, although stocks were already on hand with the local agents, S. W. Peterson & Company, Ltd., Wellington, N. Z.

A new way of handling tanks. This Link-Belt Crawler Crane moved tanks up to 15-ton weight in a recent factory installation. It took 7 minutes to move this tank 25 feet.



Road and Street Maintenance

Asphalt Heaters

201. Tar and Asphalt Kettles, Oil Burning Kettles, Pouring Pots, Torches and Hand Spraying Attachments. Full data. Connery & Company, Inc., of Philadelphia.

202. Connery & Company, Inc., 3900 N. Second St., Philadelphia, Pa., has issued a new Bulletin "J" describing the latest and improved style "J" Oil Burning Kettle for Paving Contractors, Street and Highway Departments.

203. A 54-page booklet issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates oil, wood and coal burning asphalt and tar kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools, etc.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance. It contains tables and composition, grading, etc.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barborton, Ohio.

Dust Laying

213. Solvay Sales Corporation, New York, supplies full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5 1/2 x 8, covers application, economies, etc. Sent without cost.

Equipment

215. "Road and Street Maintenance Equipment," a compact vest pocket manual containing illustrations and brief descriptions of their extensive line, has just been issued by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

216. "Light and Heavy Road Maintenance" is the title of a recent folder showing the tremendous power developed by the FWD truck and its economy for use in pulling road graders and maintainers—issued by the Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Surface Heaters

218. The new "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is fully described and illustrated in Bulletin 16 just issued by the Mohawk Asphalt Heater Co., 58 Weaver St., Schenectady, N. Y.

Road and Paving Materials

Asphalt Plank

220. The Philip Carey Company, Cincinnati, Ohio, has available a handsome booklet describing Elastite Asphalt Plank for Bridge Flooring—with specifications for use—liberally illustrated with photographs.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. A handy, useful volume, well illustrated. 47 pages, 5 1/2 x 7 1/2. The Dow Chemical Company, Midland, Mich.

Culverts, Corrugated

236. The added advantage in using Toncan Iron Culverts under highways for airport drainage, storm sewers, suburban allotments, etc., because of Toncan's alloy composition, is described in bulletin—"We are living in the Alloy age"—Toncan Culvert Mfrs. Association, Massillon, Ohio.

Culverts—Corrugated Metal

238. A new 24-page, well-illustrated catalog, listing the advantages that follow the use of Armco corrugated iron culverts and containing complete instructions for ordering and installation has been published by Armco Culvert Mfrs. Association, Middletown, Ohio. Write for Culvert Catalog No. 6.

Expansion Joint for Pavements

250. Premoulded Expansion Joints in several different types, including a new

asphalt rubber joint, in order to meet various construction conditions are covered in literature issued by the Serviced Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

251. Full information on the use of Expansion Joints in pavements, bridges, pools, walls and other concrete work, including best installation methods, may be obtained from The Philip Carey Company, Cincinnati, Ohio.

Jacking Method

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. A new catalog, "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Maintenance Materials

267. "Mixed-In-Place Construction with Tarmac." Step-by-step pictures and specifications for constructing road surfaces by Retread or Turnover methods. American Tar Products Co., Koppers Bldg., Pittsburgh, Pa.

268. Road and street maintenance and reconstruction with BITUMULS Cold Asphaltic Binder described in an illustrated paper by C. H. Thomas, Maintenance Engineer. Reprints furnished by American Bitumuls Company, San Francisco or Baltimore.

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control. It contains tables of composition, grading, etc.

272. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products is now ready for distribution. Recently published by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

273. Complete directions for surface treatment and bituminous surfacing with Cut Back Asphalt are contained in a 36 page data book just issued by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with "Tarvia-K. P." 16 pages, illustrated, 3 1/2 x 9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

277. "Tarvia." An attractively illustrated 32-page booklet describing grades of Tarvia and showing photographs of actual application. The Barrett Company, 40 Rector St., New York City.

278. Information regarding crack and joint fillers furnished in gray, black, or other colors, for poured joints, also maintenance and repair work may be obtained by application to the Serviced Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Material Handling Buckets

280. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Material Handling Buckets, showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Material Handling Buckets will also be furnished on request.

Rail Filler

281. Bituminous Rail Filler used for sound deadening, rail insulation and pavement protection is described in pamphlet issued by Serviced Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

282. Write to The Philip Carey Company, Cincinnati, Ohio, for complete and interesting data on the application of Elastite Rail Filler in Street Railway Tracks.

Sand and Gravel Buckets

290. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Sand and Gravel Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Sand and Gravel Buckets will also be furnished on request.

Garbage and Refuse Disposal

305. "Pittsburgh-Des Moines Incinerator," built and guaranteed by the Pittsburgh-Des Moines Steel Company, 3479 Neville Island, Pittsburgh, Pa., is described fully in a booklet sent on request.

Snow Removal

Snow Removal

348. "Winter Maintenance" is the title of a recent booklet issued by the Four Wheel Drive Auto Company, Clintonville, Wisconsin. Illustrates many types of snow plows and methods of handling snow removal problems.

349. "The Answer to the Snow Removal Problem" is the title of a new booklet just published by Carl Frink, Mfr., of Clayton, N. Y. It gives full details of the new Frink type S snow plow for trucks.

353. Efficient methods of combating quickly the snow menace on highways and city thoroughfares. Illustrates joint use of crawler tractors and standard and special snow plows. The Cleveland Tractor Co., 19322 Euclid Ave., Cleveland, Ohio.

354. "Snow Removal Equipment," a colorful booklet just off the press of the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill. Various types of snow-fighting equipment built for "Caterpillar" Tractors are pictured in relief and in action.

358. The new Type "S" Frink Snow Plows and Frink Leveling Wings, together with complete data for selecting the proper size snow plow for your particular make and model of truck. Published by Carl H. Frink, Clayton, N. Y.

359. Callon Iron Works and Mfg. Co., Gallon, Ohio, will gladly furnish details, prices and catalogs of their snow plows adaptable to any make of truck.

Sewerage and Sewage Disposal

Activation and Aeration

390. A new booklet describing Norton Porous Mediums of bonded fused alumina (strong, chemically stable, uniformly permeable), the booklet will be of interest to all chemical and sanitary engineers. Issued by Norton Co., Worcester, Mass.

Inlets and Manhole Covers

400. Cast iron sewer blocks, ventilators, manhole covers and inlets, valves, etc., described in pamphlet by the South Bend Foundry Co., South Bend, Ind.

Jointing Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections, described in catalogue of Atlas Mineral Products Company, Mertztown, Pennsylvania.

402. An illustrated folder has just been issued by the Cochrane Chemical Co., 432 Danforth St., Jersey City, N. J., detailing the advantages and the savings in the use of Ex-XL-cell Sewer Pipe Joint Compound.

403. A recent publication of the Serviced Sales Company, Monadnock Block, Chicago, Illinois, tells of the superior tightness, flexibility and durability of fibrated asphalt Sewer Pipe Belts and Joint Compounds. Complete instructions and considerable data are included in the pamphlet, now available.

Sewer Joint Compound

404. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight are contained in an illustrated folder just issued by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Pipe, Vitrified

405. Full information regarding Vitrified Pipe and other heavy clay products. Illustrated price list on application. Factories in Pennsylvania and Ohio. The Progressive Clay Co., offices in New York City, Philadelphia, Pa., and Syracuse, N. Y.

Equipment for Construction Economy

The New Blaw-Knox "Trukmixer"

The Blaw-Knox Company has placed on the market a truck mixing unit which is not only designed for mixing but can be used as a closed type agitating body for conveying premixed concrete.

The Blaw-Knox "Trukmixer" is claimed to overcome the difficulties which have been experienced with the truck mixing method in getting: Positive water control, thorough and uniform mixing, rapid mixing, clean discharge of all consistencies of concrete mixes, and many other details that have proven troublesome to solve.

The Blaw-Knox "Trukmixer" is featured for the production of high grade concrete mixes. The control of concrete mixing is removed entirely from the truck driver and automatic functioning of mixing, water control and discharge is provided.

The measurement of water is entirely removed from the control of the truck driver. A forced feed automatic water supply system is used which can be set for the amount of free water to be deposited into the batch of concrete, and no more water can be placed in the batch than is actually specified.

Concrete can be mixed very rapidly and uniformly with the Blaw-Knox "Trukmixer," which is especially desirable in connection with short hauls and where a dry or lean mix is used.

Blaw-Knox "Trukmixers" are made in capacities of 2, 3, 4 and 5 cubic yards for mixing, and from 2 to cubic yards for agitating pre-mixed concrete.

A Wheelbarrow Scale for Aggregate

To meet a growing demand on the part of construction engineers generally for measurement by weight instead of by volume in the mixing of concrete, Fairbanks, Morse & Co. has developed a highly accurate, light weight scale for weighing wheelbarrow loads of ingredients. All weighing can be done on the one scale, as it is provided with a tare bar and two beams, one for sand and one for stone. In every way it

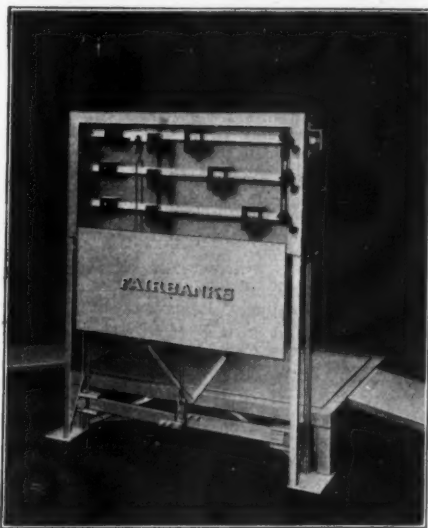


The Blaw-Knox "Trukmixer"

meets specifications prepared by the Associated General Contractors of Washington, D. C., and adopted by the American Road Builders Ass'n.

This scale provides an accurate scientific control of the mix and enables the

which has a 42-in. by 30-in. platform for weighing wheelbarrows and weighs complete only 275 lb. The other has a 42-in. by 42-in. platform, especially designed for weighing materials in carts or buggies; it weighs 320 lb.



F-M Wheelbarrow Scale

contractor to meet rigid specifications without increasing the labor cost of mixing. There are two sizes, one of

Mohawk High Speed Trailer

The Mohawk Asphalt Heater Co., Schenectady, N. Y., manufactures an all-steel tool trailer that has many advantages for the contractor, city or county. Tools can be locked up safely at night and left without worry. The body is made of 12-gauge steel, and the covers and partitions of 14-gauge. The body is 7 feet long, 3 feet wide, and 24 inches high at the peak, with tray for tools.

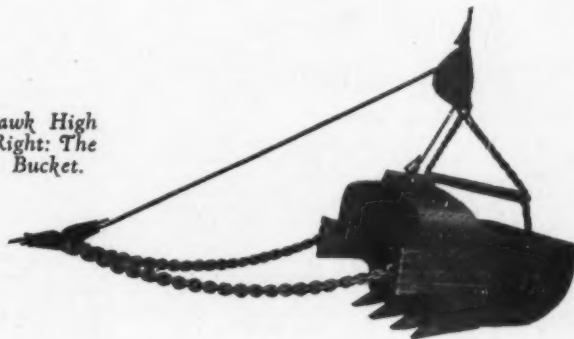
For Every Kind of Dragline Work

A new dragline bucket put out by the Erie Steel Construction Company, Erie, Penna., is suitable for every kind of dragline work. Perfect balance is obtained by locating the center of gravity with relation to the hoist trunnion brackets so that at all stages of operation the bucket is well balanced.

A four page circular describing and illustrating these buckets is ready for distribution.



Left: The Mohawk High Speed Trailer; Right: The Erie Dragline Bucket.



Sewage Screens

414. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6391, which describes the construction and operation of the Dorco Mechanically-Cleaned Bar Screen.

415. Link-Belt Company, Philadelphia, shows in Book 642 its line of sewage screens (Tark, Brunotte, and Straight-line) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit; and Mechanical Aerators for activated sludge plants.

Sewer Cleaning Machines

416. Illustrated booklet describing Adjustable Turbine Sewer Cleaners, Self-Propelling Ferret Turbines, Drag Type Sewer Cleaners, Five Types of Sewer Rods, Conduit Rods, Windlasses, Sewer Braces, Sewer Cables. Turbine Sewer Machine Co., 5210 W. State St., Milwaukee, Wisc.

Sludge Bed Glass Covers

418. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 1018B, Describing glass covers for sludge and sprinkler beds.

Storm Sewers

424. A 24-page catalog, profusely illustrated with actual installations under widely varying conditions, which lists the features that give superiority to flexible corrugated metal construction for storm sewer installations, can be obtained from Armco Culvert Mfrs. Association, Middletown, Ohio. As for the catalog No. 5.

Treatment

425. Dorr Company, 247 Park Ave., New York, in its Sanitary Engineering bulletin describes the use of its equipment for treating municipal sewage, industrial wastes and water. Photos of numerous operating plants are shown as well as representative flow sheets illustrating the various methods of sewage treatment.

427. The Pacific Flush Tank Company, of Chicago and New York, publish eight separate catalogs on Sewer and Sewage Disposal Automatic Equipment, including pumps, Imhoff Tanks and Sewer Joint Compounds. These are of real value to the designer or operator of a treatment plant.

428. Advantages of Liquid Chlorine for disinfection given in booklet issued by the Electro Bleaching Gas Co., 9 East 41st St., New York.

429. Chlorine is being extensively used in the disinfection of sewage not only as a disinfectant but as an aid to other purification processes. Wallace & Tiernan Co., Inc., Newark, N. J., have a publication, No. 42, on the chlorination of sewage, which will be sent to any address on request.

430. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6171, which describes the treatment of sewage with Dorr Traction Clarifier, an improved type of continuous sedimentation for use in water and sewage treatment plants.

432. The Dorr Company, 247 Park Ave., N. Y. C., publishes Bulletin No. 6481, which describes the construction and operation of the Dorr Detritor for continuously removing and washing the grit from sewage flows.

434. Automatic, continuous vacuum filters, producing a relatively dry cake of sludge in demand for fertilizer, are used by: Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C., write for literature, Oliver United Filters, Inc., Federal Reserve Bank Bldg., San Francisco, Calif.

Water Works Equipment

Activation and Aeration

465. A new booklet describing Norton Porous Mediums of bonded fused alumina (strong, chemically stable, uniformly permeable), the booklet will be of interest to all chemical and sanitary engineers. Issued by Norton Co., Worcester, Mass.

Couplings and Tees

485. Copper pipe for water works services and patented connections for joining to corporation stops, iron pipe, etc. Full data 23 pages 8 1/2 x 11. The Mueller Co., Decatur, Ill.

505. "Mathews" Fire Hydrants. Gate Valves and other water works appurtenances. 16 pages, 7 1/2 x 10 1/2. R. D. Wood & Co., Philadelphia.

506. Hydrants, tapping apparatus, gate locks, valves and curb cocks described in a series of bulletins issued by A. P. Smith Mfg. Co., East Orange, N. J.

Joining Materials

515. MINERALEAD for bell and spigot water mains, G-K Compound for vitrified clay sewers, also M-D Cut-Ins for making house connections, described in catalogue of Atlas Mineral Products Co., Mertztown, Pa.

Meter Boxes

526. An illustrated catalog covering meter boxes and specialties such as gate valve housing, curb boxes, meter testers, melting furnaces, joining materials, four-in-one pumps, has recently been published by the Hydraulic Equipment Co., Reading, Pa.

Pipe, Cast Iron

534. "Sand-Spun," Centrifugal cast iron pipe manufactured by R. D. Wood & Co., Philadelphia, is fully described in a valuable 16-page 6x9 booklet, containing also complete specifications of this pipe. No engineer or water works official should be without this booklet.

535. Cast Iron Pipe and Fittings, sizes 1 1/4 through 12 inches, either with or without Precaulked lead joints factory-made in the bells. Data book sent free. The McWane Cast Iron Pipe Co., Birmingham, Ala. and Provo, Utah.

536. "Weights and dimensions of Cast Iron Pipe and Fittings." A handy reference book for Municipalities and Contractors. 48 pages, 7 1/2 x 10 1/2. R. D. Wood & Co., Philadelphia.

539. U. S. Cast Iron Pipe Handbook contains useful tables and data for the Water Works man on pipe line construction. Issued by U. S. Cast Iron Pipe and Foundry Company, Burlington, N. J.

Pipe, Cement Lined

540. Steel or Wrought Iron Pipe lined with cement and special lead-lined joints, manufactured by the Cement Lined Pipe Co., of Lynn, Mass.

Pipe for Subdrainage

549. The benefits following the use of Armco perforated iron pipe for various municipal uses such as golf course, athletic field, and airport drainage; and its various applications in the construction and maintenance of highways and railroads are outlined in the 24-page illustrated catalog entitled, "Armco Perforated Iron Pipe." Catalog No. 4 is obtainable upon request from Armco Culvert Mfrs. Association, Middletown, Ohio.

Pump Packing

575. "When Power Is Down," by the Sterling Engine Company, Buffalo, N. Y., gives recommendations of models for standby services for all power requirements.

Service Boxes

578. "Service Boxes with Stay-on Covers. No more broken covers. No more lost covers." (Booklet). The Central Foundry Company, 120 Lexington Avenue, New York, N. Y.

Swimming Pools

580. Wallace & Tiernan Co., Inc., Newark, N. J., have just published a new edition of technical publication, No. 41, dealing with the sterilization of swimming pools by liquid chlorine. Copy sent on request.

Tanks and Stand Pipes

582. A 50-page booklet issued by Pittsburgh-Des Moines Steel Co., 3479 Neville Island, Pittsburgh, Pa., on complete water works plants, elevated tanks, stand pipes and filtration plants built by them.

Tapping and Valve Machines

583. The A. P. Smith Company, of East Orange, N. J., furnish descriptive matter dealing with their many labor saving devices as the Smith tapping machine, valve inserting machine and pipe cutting machines.

Valves

585. Catalog covering our line of Bronze and Iron Valves for service on Steam, Water, Gas, Gasoline, Air and Oil lines furnished upon request. Also data on "Dart" Unions and Fittings. The Fairbanks Company, 393 Lafayette Street, New York, N. Y.

Miscellaneous

Airport Construction

597. "Getting on the Air Map With 'Caterpillar,'" profusely illustrated with action pictures, describes the many uses of the tractor in building and maintaining airports better, quicker, cheaper. Caterpillar Traction Co., San Leandro, Calif., and Peoria, Ill.

Airport Drainage

599. The added advantage in using Toncan Iron Culverts under highways for airport drainage, storm sewers, suburban allotments, etc., because of Toncan's alloy composition, is described in bulletin—"We are living in the Alloy age"—Toncan Culvert Mfrs. Association, Massillon, Ohio.

Asphalt Bridge Planking

600. A new and improved asphalt composition has been developed as a long wearing and resilient paving material for bridges, viaducts, railroad platforms, etc., covered by Catalog No. 12, now available from Serviced Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

601. The Philip Carey Company, Cincinnati, Ohio, has available a handsome booklet describing Elastite Asphalt Plank for Bridge Flooring—with specifications for use—liberally illustrated with photographs.

Chains and Speed Reducers

607. Link-Belt Co., Indianapolis, Ind., gives full description of its positive drives in books. No. 125 Silent Chain; No. 1257, Roller Chain; No. 815, Herringbone Speed Reducers; No. 1050, Promal Chains. Send for these positive power transmission books.

Community Advertising

610. Booklet showing various forms of publicity matter useful in arousing interest in the construction of small town water supplies. This matter is furnished free to Consulting Engineers and towns interested in waterworks construction by The Cast Iron Pipe Research Association, 566 Peoples Gas Bldg., Chicago, Ill.

Highway Crossings

612. A most serviceable and durable railroad crossing for city streets and main highways, is composed of fibrated asphalt planking and rail filler sections. Complete description and data will be furnished by Serviced Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Industrial Flooring

615. An extremely serviceable fibrated recent contributions to industrial efficiency. Duo-Type Flooring—interlocking Asphalt Industrial Flooring is one of the sections with asphalt plank base and rubber block wearing surface offers a splendid combination of these products. Ask for pamphlets from Serviced Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Municipal Drainage Products

620. A complete line of drainage products which meets the modern municipal need for drainage materials that are quickly installed, safe, and dependable and economical in service is described in the new 24-page, illustrated catalog, "Armco Municipal Drainage Products." A request to Armco Culvert Mfrs. Association, Middletown, Ohio, for Catalog No. 9 will bring you this book free of obligation.

Rules

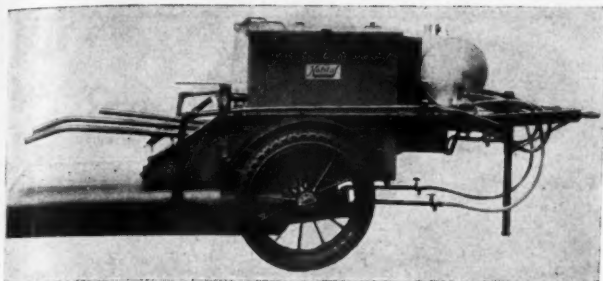
625. The Lufkin Rule Company, Saginaw, Mich.; New York; Windsor, Canada. Manufacturers of Measuring Tapes, Boxwood Rules, Spring Joint Rules, Straight and Folding Steel Rules, Fine Mechanics Tools and Aluminum Folding Rules. General Catalog No. 11.

Tree Moving

632. "Tree Moving," folder from the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill., shows and tells with action pictures and the letters of landscaping experts how to successfully move large trees.

Waterproofing and Dampproofing

635. Headley Emulsified Products Co., Philadelphia, has issued Bulletin 330, which gives some very valuable information regarding dampproofing, insulating, and waterproofing methods and materials for floors, walls, roofs, tanks, swimming pools, etc.

*Hotstuf 3 in 1 Equipment*

Hotstuf 3 in 1 Tool, Asphalt and Surface Heater

The Hotstuf 3 in 1 Combination Tool, Asphalt and Surface Heater, manufactured by the Mohawk Asphalt Heater Co., Schenectady, N. Y., is just what its name implies, three efficient equipment pieces, mounted on a single chassis.

The tool heater has a capacity of 16 paving tools. Mounted on the same frame is a 20 gallon fuel tank, which supplies the two Mohawk improved oil burning torches used to heat the tools. Bucket rack for heating small quantities of asphalt is included.

The asphalt heater, which may be purchased separately, is mounted over the tool heating compartment, being bolted to the frame, and uses the same burners which heat the tools to melt asphalt. It has a holding capacity of approximately 50 gallons and will deliver in eight hours approximately 4,000 pounds of melted material. This heater has the patented elevated melting chamber principle found only on Hotstuf Heaters.

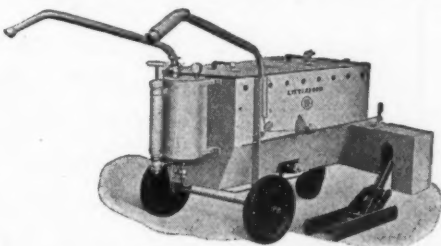
Asphalt Penetrates to the Bottom

The newly improved combination Joint Filler and Line Marker manufactured by Littleford Bros., Cincinnati, Ohio, is, according to them, just the machine highway men have needed.

Many highway men and contractors have found it difficult to satisfactorily

is hot and, therefore, penetrates to the bottom of the joint and seals perfectly.

Littleford Bros. have just issued a new bulletin covering the operations and advantages of this new Joint Filler. They will gladly send you a copy upon receipt of a request.

*No. 91 Joint Filler and Line Marker*

fill a joint with a pouring pot. The material has too much time to chill, consequently it congeals too quickly and does not penetrate to the bottom of the joint.

This Joint Filler keeps asphalt hot and applies it direct to the joint so there is no chance for cooling. When material is applied to the joint or crack, it

Warco Develops Dump Body Attachment for Power Graders

The accompanying illustration shows a new type of outfit working on the streets of North Little Rock, Arkansas, where its utility has been demonstrated. The operator can start out in the morning with a load of patching material, such as screenings, crushed stone, or whatever may be required, filling in the necessary holes along the way, and then blading down the material to form a smooth roadway all in one operation.

A dump body attachment with a capacity of $1\frac{1}{2}$ cubic yards can now be furnished on Warco Center Control Power Graders. Dumping may be either gravity or mechanical as desired.

The attachment may be secured from the W. A. Riddell Company, Bucyrus, Ohio.



The Willamette Hyster handles sewer pipe quickly and economically.



Warco Dump Body Attachment

Waterproofing Protection Course

640. Fibrated Asphalt Waterproofing Protection Course planks as now used for protection course to membrane waterproofing on railroad structures, viaducts, large roofs, etc., is described in Catalog No. 12, issued by Serviced Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

New Catalogs

Not described before in this Industrial Literature Section

Torches

91. An illustrated folder in two colors has just been printed describing the Toledo Torch for illuminating hazards on highway and other construction. Issued by the Toledo Pressed Steel Co., Toledo, Ohio.

137. Road Machinery. Comparative specifications of the various types of equipment manufactured by the Caterpillar Tractor Co., Peoria, Ill.

138. The Dorco Sand-Washer is inexpensive to install and operate, and produces a clean, drained sand with a minimum of waste. It will make separation at any point between 20 and 100 mesh. Ask for bulletin No. 4101. The Dorco Co., 247 Park Ave., N. Y.

168. "High Clearance," "Caterpillars in Mines, Quarries, Clay Plants and Pits," "The Caterpillar for Industry," "The Caterpillar for Railroads," "For the Earth Mover," are publications of the Caterpillar Tractor Co., Peoria, Ill.

172. The Caterpillar Sixty Tractor. This beautifully illustrated booklet tells the story of the Caterpillar Sixty Tractor design and construction. Caterpillar Tractor Co., Peoria, Ill.

355. "Conquering Snow With Caterpillars," "An Unwelcome Visitor Is Coming," "A Wall Ten Miles High." Three publications on the snow problem by the Caterpillar Tractor Co., Peoria, Ill.

Pumps—Sewage

410. Non-clog vertical and horizontal sewage pumps are fully described and illustrated in new bulletins just issued by the Dayton-Dowd Co., Quincy, Ill.

Filters

510. Full information concerning Roberts water-filters and filtration plant equipment, and equipment for sewage treatment plants and pumping stations can be obtained from the Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

595. Airports and Airways. A 20-page illustrated booklet by the Caterpillar Tractor Co., Peoria, Ill., describes the uses of tractors in building airports and handling planes.

Pumps, Waterworks

560. Centrifugal pumps for high or low service pumping for waterworks and filtration plants. Bulletins contain interesting installation photos, characteristic curves, etc. Dayton-Dowd Co. Mfrs. Centrifugal Pumps, Quincy, Ill.

Flexible Joints

611. Bulletin 204 containing 60 illustrations gives complete data regarding uses and specifications of Barco flexible joints for water works, sewage disposal plants, road contractors pipe lines, etc. Just issued by the Barco Mfg. Co., 1800 Winnemac Ave., Chicago, Ill.

**When You Want
Catalogs**

Consult the

**Industrial Literature
Section**

and use the coupon on Page 95

Index to Advertisements

Allis-Chalmers Mfg. Co.	79	Hill, Nicholas S., Jr.	87
Alvord, Burdick & Howson ..	87	Hitchings & Company	60
American Well Works	68	Huber Mfg. Co.	4
Artesian Well & Supply Co. ..	92	Hydraulic Equipment Co. ...	92
Atlas Mineral Products Co. ..	92	International Harvester Co. ..	62
Austin-Western Rd. Mchn. Co.	2	Jaeger Machine Co.	80
Babcock Brothers	87	Link-Belt Co.	86
Barco Mfg. Co.	72	Littleford Brothers	Back Cover
Barstow & McCurdy	87	McWane Cast Iron Pipe Co. .	78
Bay City Shovels, Inc.	92	Metcalf & Eddy	87
Black & Veatch	87	Mohawk Asphalt Heater Co. .	12
Bristol Hotel	84	Morrison Hotel	80
Brossman, Chas.	87	Mueller Co.	46
Buffalo-Springfield Roller Co.	54	Norton Company	58
Burns & McDonnell Eng. Co.	87	Orton Crane & Shovel Co. ...	9
Caird, James M.	87	Owen Bucket Company	6
Calcium Chloride Pub. Comm.	49	Pacific Flush-Tank Co.	92
Carey Co., Philip	65	Pearse, Greeley & Hansen ...	87
Carter Co., Ralph B.	84	Pennsylvania Salt Mfg. Co. .	81
Cast Iron Pipe Research Asso.	61	Piccadilly Hotel	91
Caterpillar Tractor Co.	5	Pioneer Gravel Equipment Mfg.	103
Cement Lined Pipe Co.	64	Co.	88
Cleveland, H. Burdett	87	Pirnie, Malcolm	76
Cleveland Tractor Co.	18	Pittsburgh-Des Moines St'l Co.	66
Cochrane Chemical Co.	64	Pollard Co., Jos. C.	88
Columbia Products Co.	49	Pollock, Clarence D.	88
Connery & Co., Inc.	83	Potter, Alexander	92
Cramer, Robert	87	Progressive Clay Co.	11
Cummer & Son Co., The F. D.	8	Reo Motor Car Co.	64
Dayton-Dowd Co., Inc.	64	Riddell Co., W. A.	90
Detroit Hotel	8	Roberts Filter Mfg. Co.	88
Dietz Co., R. E.	7	Robinson & Steinman	16
Dixie Hotel	88	Serviced Products Co.	73
Dodge Brothers Div.	39	Smith Mfg. Co., A. P.	49
Domestic Engine & Pump Co.	89	Solvay Sales Corp.	90
Dow Chemical Co.	49	South Bend Foundry Co.	42 & 43
Dow & Smith	87	Standard Oil Co. of Ind. ...	64
Du Pont de Nemours Co., E. I.	52 & 53	Standard Oil Co. of N. Y. ...	81
Erie Machine Shops	82	Sterling Engine Co.	88
F. W. I. Auto Co.	14 & 15	Suhr, Berryman, Peterson &	96
Fairbanks Co.	60	Suhr	10
Farasey, J. D., Mfg. Co.	83	Sweets Steel Co.	13
Frink, Mfrs., Carl H.	83	Toledo Pressed Steel Co.	90
Fuller & McClintock	87	Toncan Culvert Mfrs. Assn. .	45
Galion Iron Works & Mfg. Co.	3	Turbine Sewer Mchn. Co. ...	85
General Motors Truck Co. ...	69	U. S. Pipe & Foundry Co. ...	77
Goodrich Rubber Co., B. F. .	57	Wiard Plow Co.	85
Goodyear Tire & Rubber Co.	50	Williamsport Wire Rope Co. .	85
Hazen & Everett	87	Co.	10
Headley Emulsified Prod. Co.	83	Wood, R. D., & Co.	
Heltzel Steel Form & Iron Co.	75		
Hercules Co.	89		

When you want catalogs describing materials or equipment advertised in PUBLIC WORKS, refer to the classified INDUSTRIAL LITERATURE section beginning on page 95 and order by number.